In This Issue **WAR POLICY FOR UTILITIES**

JUL -9 1917

JOURNAL OF ELECTRICITY

VOL. XXXIX NO. 1 SAN FRANCISCO, JULY 1, 1917 PER COPY, 25 CENTS

—fortified

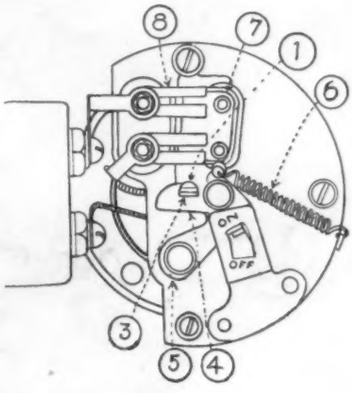
against burnouts of Heating Elements by

EXCLUSIVELY *Hotpoint*

Hotpoint Safety Switch

OPERATES AUTOMATICALLY

Hotpoint Valveless Percolators Dominate the Hollow-ware Field



Operation and Construction of *Hotpoint* Safety Switch

Illustration at left shows *Hotpoint* Safety Switch as viewed from the bottom of the appliance, with base plate removed. Explanation of numbered parts follows: The Thermostat Post, 1, composed of German Silver, is fastened to the upper inside surface of Heating Element Case, 2. The Thermostat Tongue, 3, is fastened to 1. This Tongue is composed of two sheets of metal of unequal expansion which when subjected to too much heat will bend far enough to release the Catch, 4, that is fastened to the Arm, 5, upon release of which, 4, is jerked back by the Coil Spring, 6. Thus the Blade, 7, is disengaged from the Spring Contacts, 8, opening the circuit. The Safety Switch remains in "OFF" position (shown by indicator) until it cools and operator sets it back to "ON", after which the appliance is ready for further service.

HOTPOINT SAFETY SWITCH CAN ONLY BE INSTALLED ON PERCOLATORS ORIGINALLY DESIGNED AT FACTORY FOR ITS ACCOMMODATION.

User can put appliance back into service without any expense or trouble, or without returning it to factory or dealer

Other Reasons for Hotpoint Percolator Dominance

- exclusive, valveless, troubleless Percolator Apparatus
- uninterrupted, satisfactory service
- superior high quality design and finish
- the prestige of the NATIONALLY KNOWN and ADVERTISED name *Hotpoint*

Why not specialize on such a line of Hollow-ware

and thereby protect yourself against loss of consumer good-will—costly repair upkeep—and loss of current revenue!

Write our Ontario, Cal., office for ***Hotpoint Tableware Booklet***—it illustrates and describes entire ***Hotpoint*** Tableware Line.

HOTPOINT ELECTRIC HEATING CO., Ontario, Cal.

(Service Stations at San Francisco and Seattle)

CHICAGO NEW YORK LONDON CANADIAN HOTPOINT ELECTRIC HEATING CO., Limited, Toronto, Canada

"House of Electrical Construction Material"

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JOURNAL OF ELECTRICITY

Devoted to the Generation, Distribution and Utilization of Energy

VOLUME XXXIX SAN FRANCISCO, JULY 1, 1917 NUMBER 1

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WAR POLICY OF UTILITIES

BY A. W. LEONARD

(Here is an excellent outline of a comprehensive war policy for utilities throughout the West. The inner response that is awakened in every citizen upon reading such broad gauge ideals as these serves to cement closer and closer the ties that bind in unity the utility life of the nation with the public it serves. The author is president of The Puget Sound Traction, Light & Power Company. —The Editor.)

A new problem confronts the utility managers of the country. It is that of keeping pace with increasing industrial activity on the one hand, with a material shrinkage in capital available for development or for any sort of public improvement on the other. The burden of the war must be carried through heavy taxes and the sales of bonds. The $7,000,000,000 which the people are asked to provide through taxes and purchase of war bonds during 1917 exceed the total amount the nation as a whole saves each year for investment purposes. Thus it becomes apparent that the savings which ordinarily go to further the development of industry and into public improvements will be used to carry on the war. If this is true then there will be little, if any, new capital available for the extension of industrial or transportation properties, or even for any considerable public improvements.

To summarize the situation:

The period of the war will be one of tremendous industrial activity with a correspondingly enlarged demand for labor, both skilled and unskilled.

The savings of the people invested ordinarily in industrial development and public improvements will be required almost wholly to carry on the war.

Millions of men must be diverted from the present channels of production and employed in ways that are unproductive, which is to say in the activities of war and those allied with war, or with the exclusive production of the vast machinery of destruction for the use of our army and navy. Drafts and enlistments, government departments, war relief organizations, the production and delivery of war supplies, all will require armies of workers. Cantonments must be built, a great army equipped and drilled, munitions factories, ship yards, lumber camps, steel mills must be manned and operated to fullest capacity and all of this must depend for success upon greater farming activity for all workers everywhere must be fed. All of these activities must be paid for; which means that the money ordinarily invested in railroad, utility and municipal securities will be needed by the government, and this must result in a corresponding decrease in the amount of capital available for the extension of industrial enterprises or for public improvements of any character.

Great Britain has passed through the experience upon which we are now entering. The London Economist shows in a recent issue what happened there. In 1914 there was invested in public utilities in that country $66,500,000. In 1915 only $5,000,000, and in 1916 it dropped to $600,000. In 1914 the investments for the year in municipal loans was $15,500,000; in 1915 nothing and in 1916 $2,500,000. There has been no development there for three years of any industry that did not contribute directly to war requirements.

Sensing this situation the Puget Sound Traction, Light & Power Company is preparing to meet it by the adoption of a policy of readjustment of which the following are the essential features:

Exemptions from army or navy service will be asked for only for such employes as are really needed to keep up adequate service.

To do this intelligently our employes of the stipulated age qualifications will be grouped and studied and such changes made in their employment as will enable us to serve the government to the best of our ability and yet not impair service. Men of engineering or construction experience, so far as possible, and as fast as possible, will be spared, as they will be particularly desirable for government work.

Whenever a man leaves to enter the army or navy we will first see whether or not a readjustment can be made so that his work may be handled by others in the organization, and if not will employ a woman to take his place or move up some other employe and put a woman in the place of the employe so moved.

A careful investigation will be made in every department with the purpose of discontinuing an operation which can be temporarily or permanently dispensed with without loss of efficiency or impairment of service. We will cut out detail as far as possible and devote our energies to essentials.

On all lines, wherever conditions warrant, we desire to encourage one man operation of cars, believing it will result in better and more satisfactory service. However, no man need fear losing his job if he does his work as there will be more than enough work for all available men.

We shall try to secure the co-operation of power customers, through the readjustment of hours of closing and the changing of shifts, in decreasing present peak load requirements, and will devote our own business getting energies to this end.

Renewals and replacements will have to be postponed wherever this can be done without serious detriment to service. Cost of such work at this time is excessive, and with no new capital available until government needs are provided for, the only funds upon which we could draw would be surplus from earnings. For the same reason all construction work now under way must be discontinued as far as practicable.

Careful study and consideration will be given to all rates charged for service. Labor and material are constantly increasing in cost and rates may have to be higher, too Thirty-six street railway properties in this country have recently increased rates, and other places have that matter under discussion. Unless some other readjustments can be made rate increases will have to become universal.

We will ask city officials and public authorities in this state to study the situation and aid us in carrying these policies into effect by giving us the benefit of their suggestions and co-operation.

CENTRAL STATION PRACTICE IN CENTRAL AMERICA

BY J. W. FINCH

(Much has been published in a general way during recent months, concerning opportunities in Central and South America for the American engineer. Little has, however, appeared relative to details of central station practice there in vogue. Such knowledge is quite necessary for anyone to know who hopes to mingle with our neighbors to the south either in an engineering or in a commercial way. Here is an extremely interesting article by a representative of the Journal of Electricity who is devoting a whole year in travel, informing himself on the general business and commercial conditions of Western South America. The author has had years of engineering experience in California, both in commercial and in constructive engineering effort and as a consequence this report should prove of unusual interest to engineers throughout the West.—The Editor.)

Typical Transmission Lines in Central America

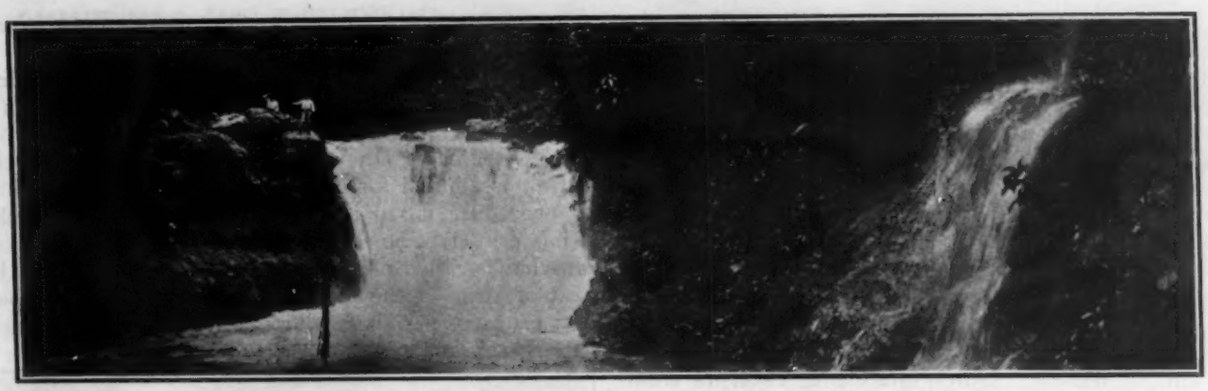
GUATEMALA, the largest of the Central American Republics, has an area of 48,290 square miles, and a population of 2,200,000. The greater part of the Republic lies at an altitude of from 4,000 to 11,500 ft. and the many plateaus are productive and healthy. The mountains are ribbed with minerals, gold, silver, copper, iron, lead, zinc, and antimony, but owing to inadequate transportation facilities, development of the mining industry has been slow. The principal product of the country is coffee, there being some 2000 coffee "fincas" or plantations producing annually something like 100,000,000 pounds. The coffee exported from Guatemala is noted for its excellence, and the value amounts to about 2/3 of the total exports of the country. Sugar, cotton, bananas, cacao, rubber, hides, chicle, mahogany, and dye woods make up the other principal exports.

Guatemala is so situated with Puerto Barrios on the Caribbean Coast and San Jose on the Pacific, that it can successfully trade with either the eastern markets of the United States or the markets of the west coast. Guatemala City, the capital of the Republic, with its population estimated at various figures between 90,000 and 125,000, is the distributing center for the entire republic.

Notwithstanding the apparent disadvantages of American Pacific Coast states in geographical relation to Guatemala we have been enjoying considerable business and much more is to be had by aggressive sales efforts and a spirit of co-operation. Our crying need at the moment is steamers to successfully handle the commerce that can be developed. Aside from the export of goods from our own ports it is safe to say that return cargoes will be guaranteed by Guatemaltecos. Of the many products of the country which could be successfully shipped to the United States west coast markets, we already know Guatemala's coffee, bananas, cacao, hardwoods, etc. Given adequate shipping facilities we should have no difficulty in successfully competing with our brothers in the East.

Guatemala City is served with electric light and power by the Empresa Electrica de Guatemala, a com-

Central America and its Relationship with the United States



One of the Many Typical Natural Water Power Sites of Central America

pany owned and controlled by German capital. This company operates under a concession which was obtained many years ago and which gives them a practical monopoly in the city. Power is generated by means of a hydroelectric plant located on the Michatoya River near Palin, 30 miles from the city. Transmission is over fabricated steel poles to a substation located in the company's office building a few blocks from the center of the city. Distribution lines about the city are carried on steel poles which consist merely of, approximately 5/16 in. by 3 3/8 in. by 7 1/2 in. I beams 30 ft. in length. Cross-arms consist of short channels bolted to the I beams by means of J bolts. Sometimes wires are carried on brackets on the side of the pole, the bracket being a special hook bolt arranged to clamp over the edge of the I beam. A barbed ground wire is invariably carried on the top of the pole. Distribution transformers are mounted on angle iron frames or platforms supported between two poles. These too, are fastened to the steel poles by means of J bolts. The remarkable feature of the entire construction being its simplicity and the fact that absolutely no holes are required in the I beam section or pole. In rare instances will be seen wooden poles but considered as a whole the distributing system is well constructed and the materials used indicate a permanency and high standard which should insure uninterrupted service.

With hardly any exception the houses here are adobe and the method of attaching service wires to the buildings is to use a steel hook bracket, cemented into the wall. The wiring in the houses is, almost without exception exposed, being run on cleats requiring but one screw, and spacing the wires about 1 1/8 in. apart and 1/2 in. from the ceiling or wall. Weatherproof wire is used inside as well as outside and in most private residence installations No. 16 is the standard size. All wiring supplies and fixtures were, until prevented by the war, imported from Germany and the system of inside wiring used is the old system which was in use in Germany many years ago, what we would call the Old Code. A peculiar custom in vogue here is, the tenant of a house has it wired at his own expense and when he moves he has the wires taken out and moved with him to his new house. This is rather hard on the tenant, but profitable for the lighting company.

The Office of the Empresa Electrica de Guatemala

Distribution Line Construction

Street Scene with Pole Lines

Although this is a city of almost 100,000 population, service, both lighting and power, is on a flat rate basis and among the rules and regulations of the Empresa Electrica it will be found that the use of incandescent or arc lamps is permitted only from nightfall until 5 o'clock in the morning and if the light is used any time during the day the Empresa (company) reserves the right to charge double rates. The operation of motors is limited to the hours between 7 in the morning and 5 in the afternoon with the exception of Sundays and holidays when there is no current. The Empresa reserves the privilege of shutting off the current any day they wish between 11 and 12 o'clock. Other interesting excerpts from the company's regulations provide that the Empresa Electrica supplies current only for those motors, lamps and other electrical apparatus that they have agreed upon and will not permit the connection of any other current consuming devices to its wires.

The service will be suspended in all cases where any suspicious installation is found, or where lamps of any other system or different size to that supplied by the company, or contracted for with the company, is found. If in the judgment of the board of directors of the company the circumstances seem to justify, in such case the service will be renewed upon the payment of double rates for six months, the consumer forfeiting all right to the use of wall attachment plugs and extension cords for portable lights. The consumer is further advised that even though he should live up to all the regulations and faithfully fulfill his contract, the company nevertheless reserves the right, at any time to suit its convenience, to discontinue the service, giving the customer one month's written notice. There are many other interesting regulations of the company and in which they are fully protected by their concession. For example, they have an absolute monopoly in the city of Guatemala both for the supply of current and the wiring of houses. Four merchants of the town have recently secured permits to sell electrical goods but they are not particularly enthusiastic as every thing they sell in Guatemala City is in a way under the supervision of the Empresa Electrica and practically all of their business must be done in the outlying cities and the country.

All payments for lighting or power service is strictly in advance and the use of heating appliances or any other special apparatus is not allowed unless the apparatus is purchased from the Empresa. The reason of course being the desire and necessity of knowing where the appliance is to be used. At this time the Empresa refuses to connect any new day-load business as they are carrying their maximum capacity. They have under construction, however, a new plant which will give them an abundance of power to supply all needs. All apparatus, generating equipment, etc., comprising the present plant, transmission and distributing system are of German manufacture. This will also be the case with the new plant excepting possibly the turbines which may be "Francis" high-head turbines. Plans were made for the new plant while Germany was still at peace, and they contemplated the use of Siemens-Halscke generating equipment and the foundations and other concrete work are being prepared, in the hopes that delivery can be made on these German machines in time to complete the plant on schedule, which will be about two years hence.

The importation of firearms, ammunition and electrical goods into the Republic of Guatemala, is prohibited by law, unless a special permit is obtained from the government. In the case of electrical goods, the permit is applied for by the importer and the method of procedure is, to address a communication to the Ministerio de Fomento (Minister of Public Works) on what is called official paper, which paper bears the coat of arms of the Republic and for which you pay fifty centavos per sheet. This official application must

Guatemala Awaits Modern Methods of Transportation

contain a detailed account of what you wish to import and a statement of the purpose or uses of the goods. If the Ministerio de Fomento approves, he passes your application on to the Ministerio de Guerra (Minister of War) and he to the Ministerio de Hacienda (Minister of the Treasury. If the approval of all of these officials is obtained, you will receive the permit within probably two or three weeks, never any less. Then you are ready to file another application for a permit allowing you to pass them through the custom house. This application follows practically the same course as the previous one excepting that it does not take quite as long to get it through. After the necessary permits are given and your goods arrive you must visit the custom house at the convenience of the inspector from the Empresa Electrica, who will go over your goods with you to see that they coincide with the items you specified on the original application. With all of this apparent difficulty, however, if the interested dealer here anticipates his wants and makes his application in due time, there seems to be little or no difficulty in importing electrical goods, excepting possibly telegraph or telephone equipment or apparatus.

The furnishing of heat, light and power service to the troop cantonments for the mobilization of the military forces located in different parts of the country is now being considered by the National Committee on Gas and Electric Service, and information is being collected as to how these agencies may be made available to the camps in the shortest possible time from the nearest points of supply.

COMMERCIAL AND ENGINEERING EXPANSION ABROAD

BY JOHN CLAUSEN

(The growing engineering and commercial relations with our Pacific foreign neighbors make this contribution by the head of the foreign exchange department of the Crocker National Bank of timely interest. In it the author tells the readers of the Journal of Electricity some of the ways in which commercial and engineering activities looking toward advancing the superiority of American goods may be made aggressive realities.—The Editor.)

It would be well to study the objects of the new "British Trade Bank" now in process of formation for the purpose—as its name implies—of furthering the commerce of Great Britain. That institution when organized and operated under efficient management, with the power to base on its capital a forceful system of credit in the shape of acceptances, will no doubt soon gather the nucleus of a large foreign business.

As a striking example of the great activities for the advancement of their international trade relations, it is of the greatest importance to recognize that British oversea banks alone have capital exceeding 500 million dollars as against but 5 or 6 million dollars so invested by North American interests.

In the economic life of a Nation commerce and banking are so closely interwoven that it becomes essential for every person engaged in business to have some knowledge of the parts played by these factors. The nature and use of money, the mechanism of exchange and the development of banking in various parts of the world are features of vital concern to the commercial interests of our country.

Co-operative combinations such as may be deemed expedient to develop our foreign relations in normal times, are essential and should in no sense be considered a contractional restraint of free trading. A recognition of this principle in oversea trade development is in my opinion most necessary to our economic progress. Such privileges very naturally should only be accorded American-owned concerns, and co-operative ownership of stock in competitive organizations must obviously be prescribed.

If the claims for superiority of American goods are made aggressive realities,—and careful, direct and persistent efforts exercised by American manufacturers in their introduction and exploitation, it should not be difficult to make permanent our present pre-eminent position in world commerce.

It appears that to advantageously maintain our place in the international relations, we need not only an efficient banking system and a well-equipped merchant marine, but more especially scientific commercial education. It cannot be too strongly emphasized that these problems must be seriously taken under advisement, as a plain matter of modern development, requiiring attention along feasible and intelligent lines.

Viewing the subject of business education from the standpoint of clear judgment, it becomes apparent that a necessity exists for training our young element in the early stages of their development for business and labors which will devolve upon them when at manhood they enter upon their active career.

The business world today is vitally interested in this problem for no organization can succeed in a material degree whose workers are not efficient. The foundation of National prosperity clearly rests upon that result accomplished by its people to serve real purposes in sympathy with current industry, science and government. If we can encourage early, direct business training, the usefulness of the populace of our country will assure both trading power and wealth.

The measure of success to which we are entitled will largely depend upon our ability to meet in organized and scientific strength the competition of foreign contemporaries. If we are to become the financial center of the world and gain supremacy in international trade, we must make adequate preparation for retaining these advantages as well as assuming all their responsibilities and obligations.

USE WATER POWER AND SAVE FUEL

Editorially, the Journal of Electricity has for some time past been strongly advocating the use of water power and the saving of fuel oil by interconnecting the hydroelectric plants of the West.

Secretary Franklin K. Lane of the Department of the Interior, in reply to a letter from the manager of an electric light and power company, made the following statement as to the policy which such companies should follow during the war in the production of electrical energy:

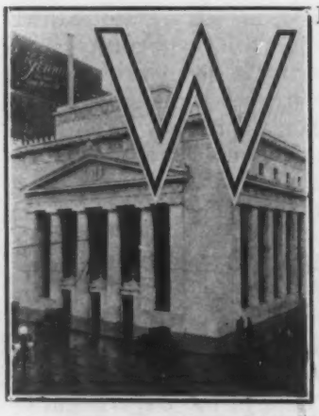
"The unusual demands arising from the entrance of the United States into the war and the necessities of the allied governments have made the situation in this country acute. We must not only supply large additional amounts of fuel for the manufacturing industries, including munitions of war, but we must to a certain extent furnish fuel to our allies. The stimulation of production, the regulation of distribution, and, within economic limits, the elimination of unnecessary consumption of fuel, are therefore problems of national interest and of immediate concern.

"Although it will be necessary to use the coal and oil now being produced to the highest possible advantage, it must be recognized that the requirements of the nation for energy are increasing rapidly, especially in regions of great industrial activity. Obviously, immediate conservation of fuels can best be accomplished by utilizing all available water power. New requirements for power should therefore be met so far as practicable by the installation or enlargement of hydroelectric plants; present requirements should be satisfied by substituting all available water power for steam generated energy requiring coal and oil for its production. This means that all water available at water-power plants should be made to produce energy up to the practicable hydraulic capacity of the works and the requirements of the population and industries within transmission distance of the site. In regions where water power can be made available steam-power plants should be operated only to carry loads in excess of those that can be carried by water-power plants. In my opinion this course should, under existing conditions, be followed by all power companies, regardless of the fact that at the moment it may be cheaper for the company to produce steam power."

BANKING INSTITUTIONS "DOING IT ELECTRICALLY"

BY F. D. WEBER

(Artistic and efficient lighting of the great banking institutions in the West has proved a problem intricate in design for the electrical engineer. The marked success not only attained in bringing about the combination of these two qualities, but in completely equipping a banking institution electrically, has called forth unusual praise at Portland, Oregon. Here is an excellent description of the beautiful results that have been obtained in illumination, burglar proofing, elevator service, time checking and other conveniences at the First National Bank in that city. The author of this article is the Portland representative of the Journal of Electricity.—The Editor.)



First National Bank Building at Portland, Flood-lighted

WHAT probably is recognized as the most pretentious and elegant bank building on the Pacific Coast has just been completed on a quarter block of land at the southwest corner of Fifth and Stark streets, Portland, Oregon, by the First National Bank.

Work was commenced in April, 1915, and the bank occupied it on November 20, 1916, after 19 months of construction work.

The exterior of the building, as designed by Coolidge & Shattuck, Boston architects, is patterned after the Athenian Parthenon, the Grecian masterpiece. Even the decorations carved in the Colorado Yule marble which, forms the exterior, are of Grecian design, and the figures which hold up a copy of the old territorial seal of the State of Oregon, are Greek forms. The entrance passageways themselves are small reproductions of Greek temples, the design differing to that extent from the Parthenon in Athens.

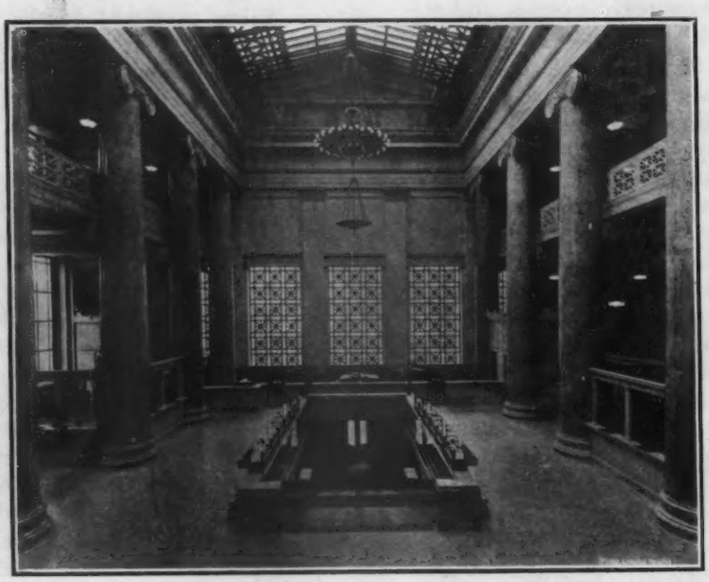
The interior of the building embraces substantially 40,000 square feet of floor space, including the basement, where the heating plant,, the locker rooms and the safety deposit vaults are located. The savings and trust departments are located on the first floor and the main banking room on the second floor, which is approached by a wide stair-way. From the second or main floor, tall sogliola (or imitation marble) columns, said to be the largest in the country, stretch to the ceiling and skylights above the mezzanine and top floors. These columns serve three floors. The mezzanine floor is given over to working space for the clerks and bookkeepers and top floor is divided into rest-rooms for the women and men employes and into storage rooms. Elevators serve both sides of the building.

The interior has been finished for the most part in Botticino (Italian) marble. The gray marble used in the floors came from Knoxville, Tenn. The office furniture used is mahogany. The decorative scheme of the interior is pure Greek, the designs having been marked out under the supervision of Pennell, Gibbs & Quiring of Boston.

The electric fixtures carry the decorative scheme out, even as regards coloring in both the fixture and glassware. This is the first installation of this character attempted in the Northwest.

The electric fixtures combine the indirect and direct methods.

The unique part of this installation is the volume of electric equipment installed in a bank building where not very much is to be ordinarily expected. In this building the following equipment is installed: All the outlets except base plugs are on separate circuits. All wire and cable are 30 per cent Standard underground cable, consisting of about 20,000 ft. feeder. There are sub-feeder cables to the extent of 60,000 ft. of duplex circuit wire. All sheraduct conduit and fittings. The main service switch is a 2000 amp. oil break switch, and the main service cables consist of three 1,000,000 cir mil cables. There are five automatic coin elevators and four passenger elevators. The installation required twenty-one motors of 120 h.p. The total number of lighting circuits is 250. Besides this equipment, ample floor outlets are installed for future connections.



Main Banking Floor, showing Artistic Features in Lighting Fixtures

THE MAIN BANKING FLOOR

In this recent creation at Portland, electricity is made to contribute every conceivable service in effective burglar protection, fire proofing, elevator facilities, and illumination effects, hitherto unattempted in banking institutions of the West.

Empty conduit is installed completely encircling each floor, for installation of future wiring of any kind that may be required. Conduit is also installed across the spaces, so that in event of running the future circuits, the floor or walls will not have to be torn up.

Practically all lights are controlled by wall switches, three and four way control being used extensively for convenience of control and economy of current.

Provision has been made for the flood-lighting of the building from across the street. For this purpose 6-500 watt close range lights have been erected on top of a building across the street.

One four and one ten point Bryant "Silent Call" signaling system for officers, is installed.

The building owns all the conduit in which the Pacific Telephone & Telegraph Company and the Home Telephone Company have their service installed inside this building. This was installed by the electrical contractor during the construction period. There are 56 telephones in use.

The three main fixtures, with 6 circuit capacity each, are controlled from the second floor through Cutler-Hammer solenoid switches.

All the motors are remotely controlled, by Cutler-Hammer remote control apparatus, from a point in the basement in the boiler room with a pilot light signal on each.

A 5 h.p. stationary Blaisdell vacuum cleaner system is installed in the basement.

All of the electric cabinets have brass fronts—bronzed. The panel boards are white Italian marble.

Interior of Bank, Electrically Lighted

They were manufactured by the Western Electric Works, Portland, Oregon. The vaults are protected by the A. D. T. Co.'s burglar alarm and it, together with all other signal systems, are in conduit.

All rheostats and control apparatus throughout the building are installed in ventilated iron cabinets. Great Western refillable fuses are used throughout as a regular maintenance man will be in charge.

One of the features of the interior is a large wall clock located at the west end of the banking room facing the entrance. Besides this one there are two others, and they are all operated from a duplicate storage battery of 12 cells at 24 volts. Howard clocks are used.

It is so inspiring to know that it was the intention to have this building the best "wired" building of its type in the country, and no expense was spared to make the electrical installation complete, and to provide for the future possibility in the electrical line.

The specific equipment is as follows:

Lighting

22 cirs. in basement, west side.
22 cirs. in basement, east side.
60 cirs. in first floor.
52 cirs. in second floor.
36 cirs. third floor.
28 cirs. in fourth floor.
24 cirs. in attic.
6-500 watt flood-lights.

Power

1-5 h.p. on exhaust (foul air).
1-5 h.p. on air washer.
1-7½ h.p. on fan fresh air.
2-5 h.p. on sump pumps.
1-5 h.p. on exhaust fan.
1-½ h.p. air compressor.
1-5 h.p. vacuum cleaner.
2-5 h.p. pumps for boiler feed.
2-5 h.p. fans circulating air.
2-5 h.p. air washers.
1-2 h.p. exhaust fan.
3-8 h.p. elevators.
5-½ h.p. coin elevators.
47 adding machine motors.

THE FOREST COVERING AND ITS RELATIONSHIP WITH STREAM FLOW

An interesting paper was recently presented at the Forest Supervisors' meeting in Portland, by Wm. B. Osborne, Jr., on the subject of "What does forest fire protective work accomplish for the public?"

In his concluding remarks the speaker brought out the fact that the maintenance of the forest cover for regulating stream flow, is an aspect of immense portance, unmeasurable mathematically, but in many localities admittedly of much greater value to the public than the potential value of the timber as a raw product. As a suggestive illustration of simply one phase in which the forest cover tends to regulate stream flow, he referred to a study recently completed on the influence of Douglas fir forests upon the melting of snow. In this work, a detailed study was made on numerous sites of varying aspects and elevations, of the rate of melting in the timber as compared with the rate of melting in the open. The conclusions were that the forests on the flat retarded melting sufficiently to prolong the supply an average of three weeks after the open ground was bare; the forests on the mountain slopes retarded the melting for periods of from six to seven weeks, and on the average. the water equivalent of the snow remaining in the timber after the open ground became bare was thirteen inches.

These figures are more incisive than any so far brought to light by the forest service and tend to confirm what had been anticipated; that is that any extensive denuding of the forest cover would result in disastrous floods. On the other hand this retarding of the melting, taken together with the natural moisture conserving characteristics of the forest floor, tends to protract the run off so that a considerably larger volume is available for irrigation throughout the dry season. The enormous sums spent in constructing ditches and artificial reservoirs for increasing the minimum flow of streams both for irrigation and power development, tend to emphasize the inestimable value of our forest cover as a natural reservoir. Its effect upon transportation and in the maintenance of a pure and ample water supply for municipalities, is so clear and yet so ramifying that it is simply mentioned.

ROAD MILEAGE IN CALIFORNIA

According to the reports received, California had at the close of 1914 a total of 61,039 miles of public roads, of which 10,279.73 miles, or 16.84 per cent, were surfaced. Of the surfaced roads 929.19 miles were concrete 837.4 macadam, 877.9 bituminous macadam, 3,563.59 gravel, 582.25, sand-clay, and 3,489.4 oiled earth.

HYPERBOLIC ANALYSIS FOR ENGINEERING PROBLEMS

BY W. D. PEASLEE

(Analysis by means of mathematical equations involving hyperbolic functions is often difficult of application due to a lack of groundwork in handling these important weapons of higher mathematics. In the issue of May 15, 1917, the author laid down the fundamental principles involved in such work. In the following pages he cites definite problems for solution and carries the solution to a conclusion. The engineer should find this article of unusual helpfulness in tackling problems of this nature in the practical application to electrical engineering. The author is in the department of electrical engineering at the Oregon Agricultural College and is also a well-known consulting engineer of Portland.—The Editor.)

The values of mx, cosh mx, and sinh mx for fifty mile intervals of x from 100 to the generating end of the line (x = 500) are tabulated in Table I for convenient reference. These values are taken from one of the tables in the bibliography.

Table I.

x miles	mx	cosh mx	sinh mx
100	.0154 + j.2605	.978 + j.003	.017 + j.205
150	.0231 + j.31	.952 + j.0078	.023 + j.305
200	.0308 + j.413	.917 + j.012	.028 + j.398
250	.0385 + j.517	.871 + j.018	.032 + j.495
300	.0462 + j.62	.815 + j.027	.038 + j.581
350	.0540 + j.724	.743 + j.036	.040 + j.663
400	.0616 + j.827	.677 + j.045	.042 + j.736
450	.0693 + j.930	.599 + j.056	.0435 + j.804
500	.0770 + j1.032	.514 + j.068	.0410 + j.844

$E/m_1 = 144{,}000/(383 + j74.6) = 361 - j70.4.$

$I = 150{,}000 / (250 \times 3^{1/6} \times .85) = 408$ amps $= 347 - j214$ amps.

For the generator end x = 500 and for no load I = O so

$e_g = E \cosh mx = 144{,}000\ (.514 + j.068)$

$= 74{,}100 + j9790$

$= 74{,}700\ /7^\circ\ 31'.$

$\Phi = \tan^{-1} 9790/74{,}100$

$= /7^\circ\ 31'.$

The voltage for no load at other points in the line is computed in the same way using the proper values from Table I and the results are plotted in Fig. 4.

For no load current

$i_g = E/m_1 \sinh mx = (361 - j70.4)\ (.0410 + j.844)$

$= 75.4 + j302$ amps.

$= 312$ amps.

$V = \tan^{-1} 302/75.4 = 76^\circ\ 31'.$

$\theta = V - \Phi = 76^\circ\ 31' - 7^\circ\ 31'$

$= /69^\circ.$

In connection with the angles Φ, θ, and V it should be noted that positive j indicates a leading vector with reference to the reference vector and,

Φ = the angle between E and e_x referred to E as a base.

V = the angle between E and i_x referred to E as a base.

θ = the angle between e_x and i_x referred to e_x as a base.

Thus at no load the generator current leads the generator voltage by an angle of 69°. The charging current at other points has been calculated and plotted in Fig. 4.

For full load,

$e_g = E \cosh mx + m_1 I \sinh mx.$

$= 144{,}000\ (.514 + j.058) + (347 - j214)\ (383 + j74.6)\ (.0410 + j.844)$

$= 128{,}160 + j133{,}800.$

$= 185{,}000 \quad \Phi = /46^\circ\ 8'.$

$i_g = I \cosh mx + E/m_1 \sinh mx.$

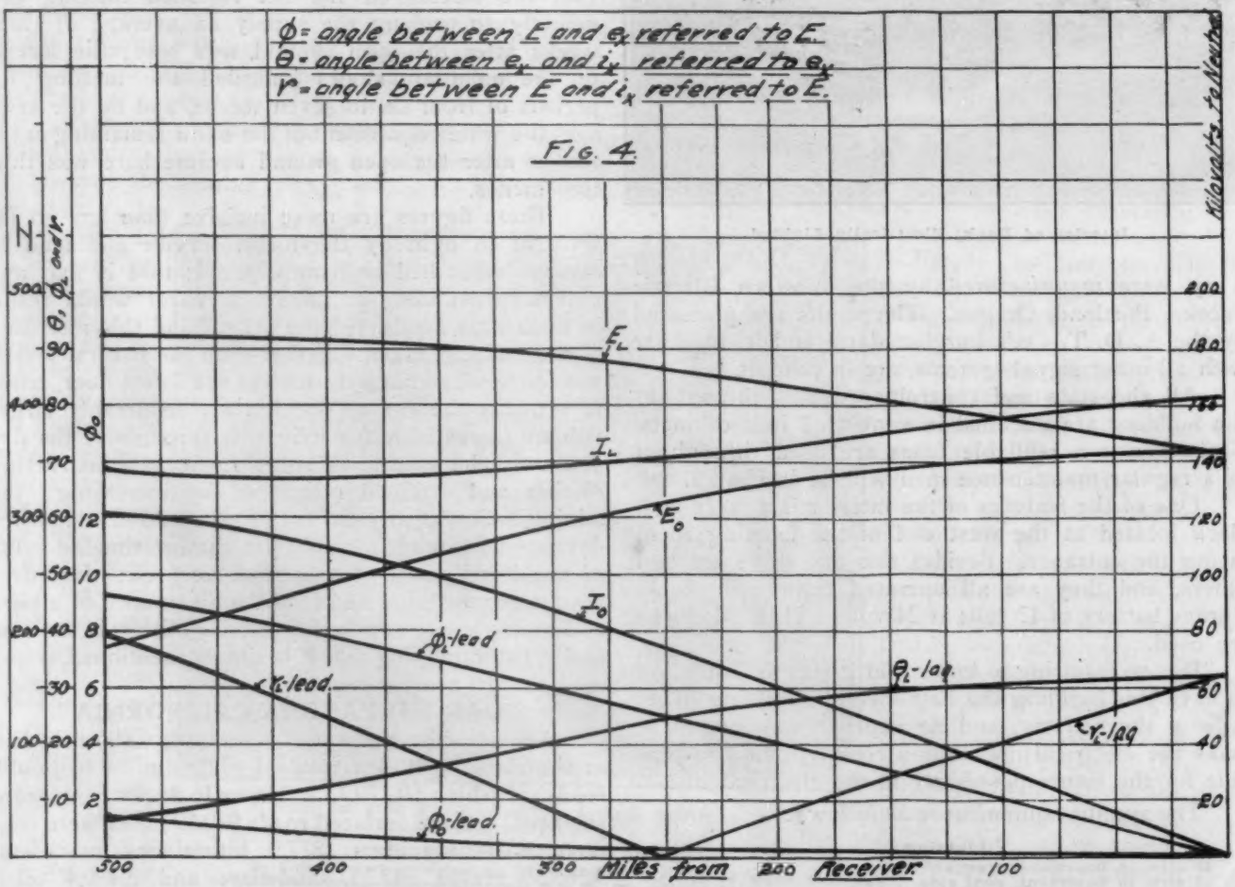


Fig. 4. Chart showing Charging Current at Various Points in the Transmission System

$= (347 - j214)\ (.514 + j.068) + (361 - j70.4)\ (.0410 + j.844).$

$= 267.9 + j215.6 = 341$ amps.

$V = 39°.$

$\theta = 7° 8' = \angle -7° 8'.$

Thus at full load the generator current lags the generator voltage 7° 8′ while the generator current leads the receiver voltage 39°. The full load values of current, voltage and Φ, V, and θ have been computed and plotted in Fig. 4 from which much interesting information can be drawn. For instance the receiver current is greater than the current put into the line by the generator.

This set of curves also shows the need of synchronous condensers at the receiving end of the line. Also it furnishes a means for determining the conditions necessary in order that this line may be paralleled with another line at a point say 300 miles from the receiving end. Thus without regulation such a line would be subjected to voltage variations of 60,000 volts (line to neutral). By assuming different condenser capacities at the receiver the proper capacity for keeping the voltage at the tapping in point within the desired limits can readily be determined and the complete characteristics of the line under these conditions determined.

In the case of the line as assumed with no power-factor correction the efficiency and power-factor at the generator are,

$$\text{Efficiency of line} = \frac{150{,}000}{185{,}000 \times 3 \times 341 \times .992} 80\%$$

Generator Power Factor under no load $= \cos 69° = .358$ leading.

Generator Power Factor under full load $= \cos -7° 8' = .992$ lagging.

While the hyperbolic functions are very useful in the investigation of the case shown their field is by no means limited to this and a very important field in which they may be employed with profit is in the higher frequencies met with in telephone and telegraph work. As an illustration the following problem will be of interest:

Given a telephone cable of the following constants:

R = 88.4 ohms per loop mile.

C = .055 m.f. per loop mile.

L and G negligible.

f = 1000, so w = 6280.

Length of cable 10 miles.

Required the voltage and current at the sending end when the receiver current is 1.25 milliamperes.

$m = .174\ \angle 45° = .123 + j.123.$

$z_0 = \sqrt{R/jwC} = 505\ \angle -45° =$ surge or sending end impedance.

The impedance of the receiving instrument z_r for different currents is given in Table II.

Current in Milliamperes.	Impedance.
1.0	$850\ \angle 66° 40'$
2.0	$900\ \angle 67° 25'$
4.0	$975\ \angle 68° 5'$
6.0	$1030\ \angle 68° 15'$

Equations may be derived for this problem as follows:

$z_1 =$ final sending end impedance $= e_1/I_1$

$= z_0\ (z_r \cosh m1 + z_0 \sinh m1)/(z_0 \cosh m1 + z_r \sinh m1).$

$z_2 =$ final receiving end impedance $= e_1/I_2$

$= z_0 \sinh m1 + z_r \cosh m1.$

$I_1/I_2 = \cosh m1 + z_r/z_0 \sinh m1.$

$m1 = 1.23 + j1.23$ and from charts, Figs. 1 and 2 we have

$\text{Cosh } m1 = .62 + j1.50 = 1.62\ \angle 67° 33'.$

$\text{Sinh } m1 = .52 + j1.78 = 1.86\ \angle 73° 43'.$

$z_r = 860\ \angle 66° 54'.$

$z_r/z_0 = 1.7\ \angle 111° 54'.$

$z_0 \sinh m1 = 505\ \angle -45° \times 1.86\ \angle 73° 43' = 938\ \angle 28° 43'$

$= 823 + j450.$

$z_r \cosh m1 = 860\ \angle 66° 54' \times 1.62\ \angle 67° 33'$

$= 1395\ \angle 134° 27' = -995 + j978.$

$z_0 \cosh m1 = 505\ \angle -45° \times 1.62\ \angle 67° 33' = 818\ \angle 22° 33'$

$= 756 + j314.$

$z_r \sinh m1 = 860\ \angle 66° 54' \times 1.86\ \angle 73° 43'$

$= 1600\ \angle 140° 37' = -1238 + j1015.$

$z_0 \cosh m1 + z_r \sinh m1 = -482 + j1329$

$= 1413\ \angle 109° 54'.$

$z_2 = z_0 \sinh m1 + z_r \cosh m1 = -172 + j1021$

$= 1036\ \angle 99° 32'.$

$z_1 = 505\ \angle -45° \times 1036\ \angle 99° 32'\ /1413\ \angle 109° 54'$

$= 371\ \angle 55° 22'.$

Then numerically

$e_1 = I_2 z_2 = .00125 \times 1036 = 1.295$ volts effective.

$I_1 = e_1/z_1 = 1.295/371 = .00347$ amperes.

$I_1/I_2 = .00347/.00125 = 2.77.$

Again we find these functions useful in the solution of problems involving the sag of cables. The equations of the catenary, which curve is followed closely by a flexible cable hung between two supports are,

$s/c = \sinh x/c.$

$y/c = \cosh x/c$ wherein s = length of arc from lowest point to support.

c = H/w.

w = weight per unit length.

H = horizontal tension at the lowest point.

Problem: A flexible conductor whose length is 30 ft. is suspended between two points 20 ft. apart in the same horizontal.

Find the depth of the lowest point.

$x = 10$ and $s/c = 15/c$ so let $10/c = u$ and we have $1.5 = \sinh u$ and from the graph of $y = 1.5\ u$ and $y = \sinh u$ (Fig. 3) we find that $u = 1.6$ nearly or interpolated from tables $u = 1.6221$.

Then $c = 10/u = 6.1649$.

$y/c = \cosh 10/6.1649 = \cosh 1.6221 = 2.6306.$

$y = 6.1649 \times 2.6306 = 16.2174$ and required depth is $y - c = 10.0525$ ft.

In the solution of problems met with in certain beams these functions are very convenient as shown in the following example.

A beam built in at one end carries a load P at the other end and is subjected to a horizontal tension Q applied at the same point. Find the equation of its neutral surface and the deflection for a given load and tensile force.

The fundamental equation of such a beam is well known and is $EI\ d^2y/dx^2 = M = Qy - Px$ which may be written,

$d^2y/dx^2 = n^2\ (y - mx)$ wherein $m = P/Q$ and $n = Q/EI$.

Let $y - mx = u$ and $d^2y/dx^2 = d^2u/dx^2$ and we have $d^2u/dx^2 = n^2u$

and solving this equation for u

$u = A \cosh nx + B \sinh nx$ or

$y = mx + A \cosh nx + B \sinh nx$.

Now at the free end

$x = o$ and $y = o$ so $A = o$ and $y = mx + B \sinh nx$.

$dy/dx = m + nB \cosh nx$ but at the fixed end $dy/dx = o$ and $x = so$.

$B = -m/n \cosh nl$, so we have

$y = mx - m \sinh nx/n \cosh nl$ is the equation of the neutral surface.

Now to find the deflection of the loaded end let $x = 1$ and $y = ml - m/n \tanh nl = m\ (1 - 1/n \tanh nl)$.

Given: A cast iron beam 2" x 2" section and 6' span built in at one end carrying a load of 100 lb. at the other and subject to a horizontal tension of 8000 lb. applied at the point of load. Find the deflection of the loaded end.

$I = 4/3$

$E = 15 \times 10^6$

$Q = 8000$ $\qquad y = 1/80\ (72 - 50 \tanh 1.44)$

$P = 100$ $\qquad = 1/80\ (72 - 44.69)$

$n = 1/50$ $\qquad = .341$ inches.

$m = 1/80$

The charts attached are not original but will be found in more or less complete form in several of the bibliography references with complete details for their solution. Drawn to the proper scale for the problem under consideration they form a very rapid and accurate substitute for the published tables which must be interpolated for values not tabulated.

For values of Cosh x and Sinh x greater than published in the tables they may be computed to any desired accuracy by means of the series.

$$\text{Cosh } x = 1 + x^2/2 + x^4/2 \times 3 \times 4 + x^6/2 \times 3 \times 4 \times 5 \times 6 + \text{- - - - -}$$

$$\text{Sinh } x = x + x^3/2 \times 3 + x^5/2 \times 3 \times 4 \times 5 + x^7/2 \times 3 \times 4 \times 5 \times 6 \times 7 + \text{- - - - -}$$

or if tables of e^x and e^{-x} are available they may be computed from the formulae,

$$\text{Cosh } x = 1/2\ (e^x + e^{-x})$$

$$\text{Sinh } x = 1/2\ (e^x - e^{-x})$$

Excellent tables of complex hyperbolic functions are given in numbers 2, 5, 9, and 10 of the bibliography and very complete tables of all the natural functions and e^x and e^{-x}, as well as many other valuable tables are given in 4.

Many other illustrations could be given of the use of hyperbolic functions in the solution of engineering problems if space were available but the ones given will show enough of the advantages of the method to bring out the value of this branch of mathematics as a tool for engineers in the solution of many otherwise very tedious problems. It is hoped that these illustrations will arouse the interest of engineers more generally to a use of more of the conveniences of the different branches of mathematics available.

Any engineer by the study of the references listed in the bibliography attached can acquire a working knowledge of the use of these functions and will in certain problems save a great deal of work thereby.

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THE BRIGHTNESS OF TUNGSTEN FILAMENTS

The appearance of the spiral filament of an incandescent tungsten lamp presents an interesting problem in radiation. The inside of the turn in the helix is much brighter than the outside. Measurements of the brightness of the two made with a photometer, using a gas-filled lamp showed that the interior of the wire was 1.87 times as bright as the outside of the wire. Opinions however, differ as to the cause of this difference in brightness, but experiments carried out at the Bureau of Standards by W. W. Coblentz, which will be published as Scientific Paper No. 300 show that the increased brightness of the interior is produced by the multiple reflection of light from adjacent turns of wire.

It was at one time believed that the difference in brightness might be due to a difference in temperature, but the work of Worthing upon the heat conductivity of tungsten and the work of Langmuir show that this is not a possible explanation. The latter found that the temperature difference could not be greater than 5 deg. C., whereas a difference of about 200 deg. C. would be necessary in order to account for the observed difference in brightness.

The reflecting power of tungsten is lower in the blue end of the spectrum than in the red, hence the intensity of light emitted by one turn of the helix and reflected from another turn is more depleted in the blue than in the red. Multiple interior reflections would thus cause the color of the light from the interior to be redder than that from the exterior. The latter would be relatively more intense in the blue. The difference in this respect is so small however, that special care would be required to observe the effect

The filament in a gas-filled lamp is wound helically in order to reduce the loss of energy by conduction and by convection. Ordinarily the efficiency of a source of light is increased by decreasing the infra-red radiation. In this case a helical filament has its luminous efficiency reduced by making the radiation from the interior more nearly the same as that from a black body, but the advantage gained by cutting down the losses of energy by conduction and convection more than counterbalances this effect, so that there is a net gain in efficiency.

GEMS OF SALESMANSHIP

BY CHARLES M. SCHWAB

(In speaking recently before the annual meeting of the world's congress of salesmanship at Detroit on the subject of super-salesmanship the chairman of the Board of the Bethlehem Steel Corporation uttered some notable gems on salesmanship that may well be borne in mind by men of the electrical industry throughout the West.—The Editor.)

The highest salesmanship consists in making a buyer understand the true merits of the article you are seeking to sell. My experience has taught me that the effort to make a man buy something he does not need in the long run defeats its own purpose.

The great salesman must have profoundly at heart the interests of his customer, for no business can develop except as it promotes the interests of those who use its goods or its services. In salesmanship the greatest possible unselfishness is the most enlightened selfishness.

The super-salesman will not only study the immediate needs of his customers but he will provide against those needs even before the customer realizes that they exist.

Business must be profitable if it is to continue to succeed, but the glory of business is to make it so successful that it may do things that are great chiefly because they ought to be done.

I have had some experience as a salesman, and I have found that it is a great deal easier to sell a big thing than to sell a little thing. It was easier to sell the Carnegie Steel Corporation to Mr. Morgan for $500,000,000 than it would be to sell a $100 piano to a farmer who was not interested in music.

One of the greatest elements of skill in a salesman is to create in the mind of the customer the thought that the salesman will in fact be able to produce the goods which he is trying to sell. The samples may be fine, but the customer must know that the man in the factory behind the samples will also do his part to the uttermost.

The supreme salesman, furthermore, must be a man who can not only make the customer want to buy, but who can also make the salesman's own producing organization equally enthusiastic to deliver the goods.

That is something new in salesmanship. I may induce you to buy large quantities of goods from me, but unless I can induce my organization down to the humblest workman, to want to produce those goods, economically and efficiently my skill in selling you the goods is wasted.

It is easy enough to sell goods if the price is made very low. Good salesmanship means getting a good price for good material. I make it a point in our companies to have the salesman personally participate in the profits based on their individual sales. It is not always the best salesman who sells the greatest quantity of goods, but it is the best salesman who sells the greatest quantity at the best price.

The opportunity for the salesman in that new world which will confront us at the close of the war will be one of the great openings of all history. Up to now we have been largely concerned with our domestic problems both in politics and in business. The end of the war will find us engaged in world politics, in international trade, and in world affairs on the largest possible scale.

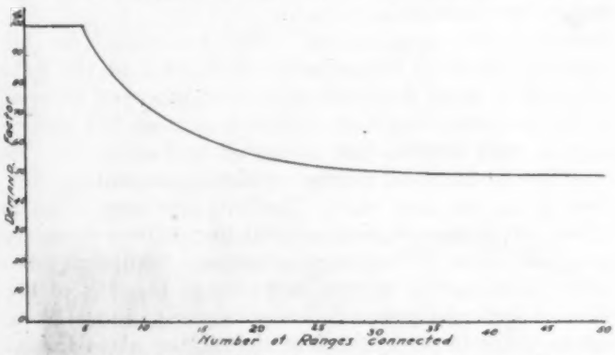
We should prepare to carry American methods and American ideals to all parts of the world to build and to develop. This war is going to result in the world moving forward in a few years as much as ordinarily would require centuries. Of this vast expansion of world effort and energy I predict that the steel business will form the basis just as it has been the basis of our own national development in the past twenty-five years.

The salesman of the future will not be merely contented to triumph over his competitor. We are entering an era of co-operation where we are beginning to see that the success of any business does not consist in failure of its competitors.

The super-salesman is a man true to the interests of his customer and whose supreme purpose is to quicken the imagination of his customer and make the customer see the true virtues of the goods the salesman is selling; the super-salesman foresees the needs of his customers and provides against those needs in full faith that the event will justify his foresight; the super-salesman puts his ideals above his profits, in full confidence that profits will surely accrue to fine ideals intelligently executed; the super-salesman places his all at the disposal of his country in its hour of need and now looks forward eagerly to the coming of peace and the opening of the greatest era of constructive effort and rapid development of civilization which mankind has ever known.

A DEMAND FACTOR CURVE

This demand factor curve for determining the size of electric range feeders in buildings, has been adopted by the electrical board of appeals of the city of Portland, Oregon, as part of the electrical ordinance, on



March 10, 1917. This is the first attempt by any municipal electrical department to depart in a scientific way from an arbitrary cut on feeders of this character, while a great majority still demand full connected load. This curve was based upon test data and a large factor of safety has been used to insure ample capacity at all times.

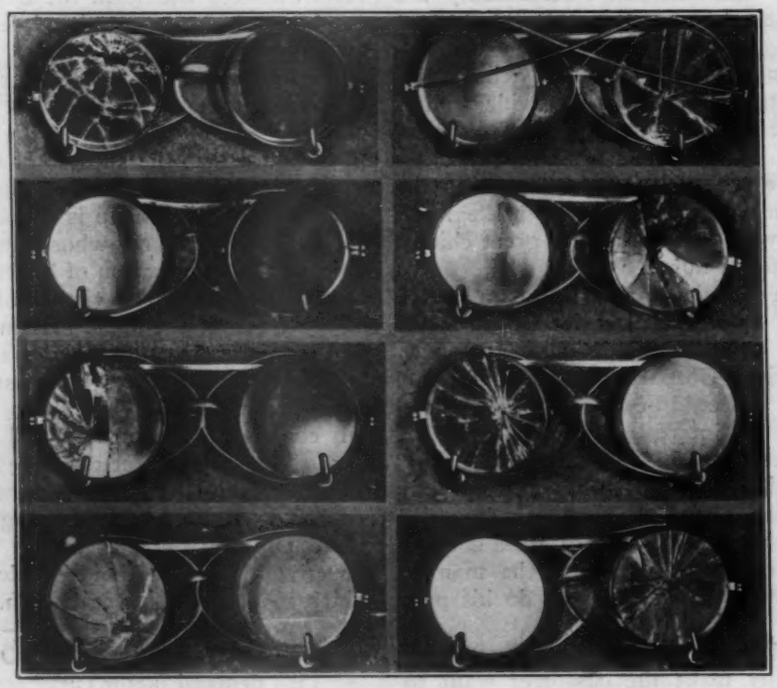
EYE INJURIES AND THEIR PREVENTION

BY JOHN R. BROWNELL

(Eye injuries and their prevention is a subject of growing importance among all the industries of the West. Engineers and central station managers are constantly coming face to face with accidents which under proper and scientific care could be avoided. Here is an excellent article on certain phases of accident prevention written by the Superintendent of Safety for the California Industrial Accident Commission that should prove of timely interest to all engaged in the up-building of industrial life in the West.—The Editor.)

A workman was once asked, "Would you willingly allow your small son to throw pebbles at your face and then expect to dodge them, if he were right in front of you?" "Why, no; of course not," he replied; "He wouldn't try it more than once!"

And yet that same workman was daily subjecting himself to the chance of a far worse bombardment of steel chips, for he was operating an air hammer in a steel foundry. He had been provided with "chipper's" goggles to protect his eyes, but carried them in his pocket or on his cap rather than endure the slight discomfort of wearing them. The attitude of that workman is not in any way out of the ordinary, for it is the stand frequently taken by men subjected to the "eye hazard." The records of the Industrial Accident Commission show that in the year 1915 there were, in California, 6807 reported injuries to the eyes of workmen. Of this number 175 caused loss of sight or total loss of one or both eyes.



A SILENT ARGUMENT FOR EYE PROTECTION

These goggles were worn by steel riveters and chippers. In each case where the glass was cracked or broken out there was no injury to the eyes of the wearer.

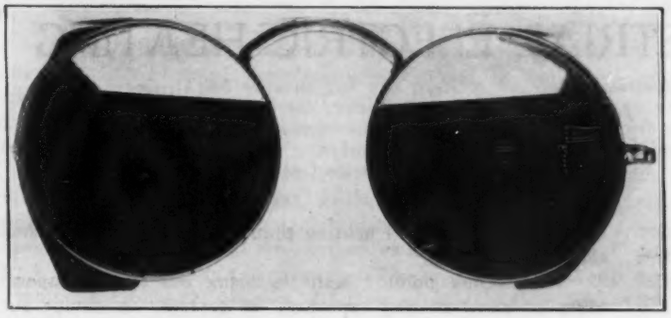
The problem of getting workmen to protect their eyes is not an easy one. The criticism very often is given by the men themselves that they cannot properly see their work if they wear goggles. Sometimes the work is of such a nature as to cause fogging of the glasses and consequent blurring of the vision. Then, again, there is present a fear that if the glass should be broken by some flying particle, it would enter the eye and cause a worse injury than that which would result from the particle itself. In answering this it can be said that in a large number of instances which the writer has known of personally, where the glass was cracked or shattered, only one or two resulted in any glass reaching the eyeball, and in no case did it result in more than a minor injury to the wearer.

It is reasonable to assume that there is a definite time interval between the instant of contact with the glass and the time when any flying particle of the broken glass could reach the eye, and it is a fairly well established fact that in the brief period following the blow on the glass, the eyelid automatically closes by reflex action of the muscles. The construction of the glasses is often such that it actually causes the glass to fly outward and away from the face when it receives a blow sufficient to break it. There are hundreds of broken goggles to be seen which were cracked in dozens of pieces, and which doubtless saved the eyes of wearers, where the glass can readily be pushed "out," but where it is beyond the strength of most hands and fingers to press the glass "in," as there is present a distinct and valuable arching or cantilever effect of the glass as arranged in the rims.

There are many ways in which eye injuries are caused. Probably the most common are those due to small flying particles. These may be broken pieces of drills, chisels, hammer heads, etc., pieces of metal resulting from chipping or from milling machines and lathes of the high speed type, from particles in grinding wheel operations and stone cutting. Nails sometimes fly when struck and cause nasty eye injuries.

Chemical fumes are responsible for many cases of lost eyesight. Ammonia fumes and fumes from bromine and chlorine are apt to cause excessive "watering" of the eyes and result in the sufferer's walking into some dangerous place with a resulting injury more or less serious.

Workmen should receive special protection in the

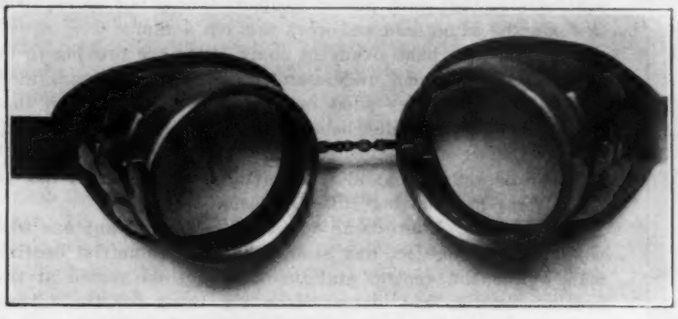


FURNACEMAN'S GLASSES

These are of cobalt blue with clear glass in the upper part. The lower part is used when looking at the molten metal.

RUBBER-CASED GOGGLES

These are worn as protection against acids, fumes and smoke.



GOGGLES USED IN DUSTY OPERATIONS

Where there is danger from flying metal, rock and wood splinters these goggles are used.

COLORED GOGGLES FOR OXY-ACETYLENE WELDERS

way of soft rubber-rimmed glasses when working in wood alcohol fumes, as total loss of eyesight often follows continued exposure to them. Chemical fumes should be eliminated as far as possible, or gas tight helmets or goggles be worn by those compelled to work in such places.

Burns are responsible for eye injuries where goggles or masks are not worn by workers around molten

BABBITTING MASK

This mask is made of fine mesh screening with large glass covered spaces. The inside is arranged to fit on the head like a cap or a baseball mask.

metal and liquid glass during the manufacturing process. Many a man has lost his eyesight when pouring babbitt. This hazard is so clearly recognized that regular "babbitting masks" and helmets are now on the market.

The selection of lenses is of prime importance, as different kinds of work require distinctly different grades of lenses. There is no economy whatever in using ordinary cheap glass, for when struck it will be apt to shatter and fly. Specially annealed glass, carefully ground, is now provided in the best makes of goggles. There are two things in general to be considered in choosing lenses, namely, the thickness and color. It is a mistake to require thick lenses to be worn by grinders, but it is essential that tough, heavy lenses be used by chippers. Unprotected eyes of grinders are subjected to a constant fusilade of fine particles which often cause inflammation, accompanied by severe pain. When small particles are removed from the eyeball a minute cut often results, which in turn leaves a scar. If these become numerous enough they will fog the vision and serious impairment of sight will result.

Electric arc welding requires the use of lenses combining both blue and red glass. These absorb the harmful ultra-violet rays of the arc and tend to diminish the so-called infra-red or heat rays. Proper selection of lenses will prevent serious eye burns which sometimes develop several hours after the unguarded eyes of the welder are subjected to the rays. The pain is very severe and cases have been known to develop into blindness.

The workman's objection to wearing goggles is the problem which the employer should and can over-

(Concluded on page 34)

POSSIBILITIES OF INDUSTRIAL ELECTRIC HEATING

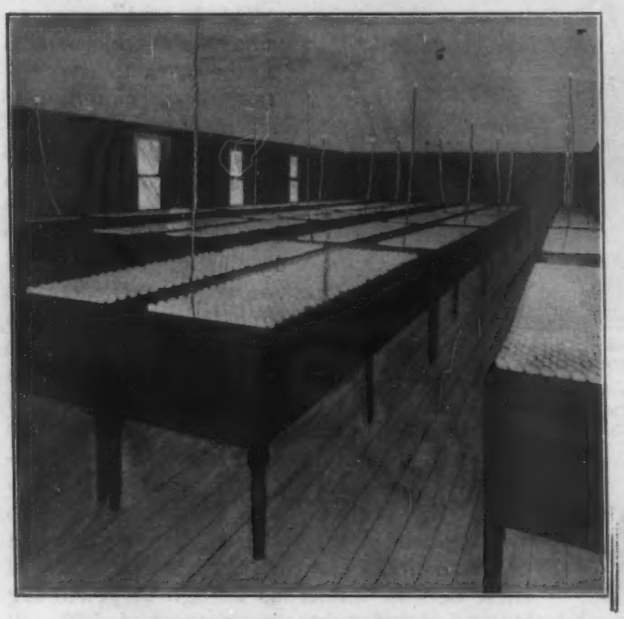
(The application of heat energy in the industries by means of electricity has an ever brightening aspect in the West, where constantly unfolding opportunities offer new incentives for industrial development. Here is a discussion on industrial electric heating by a group of prominent men in the electrical industry which deals with many new and interesting phases of this subject. This discussion is the stenographic report on this subject at the Riverside convention of the Pacific Coast Section, N. E. L. A., April 19-21, 1917.—The Editor.)

Chairman S. V. Walton: Yesterday's meeting was so short that we did not have time to finish the three subjects set, and we will start this morning on the paper on "Industrial Heating," which has been prepared by Mr. Holloway of the San Diego Consolidated Gas & Electric Company, and printed in full in the Journal of Electricity of April 15th. Mr. Holloway will not attempt to read the paper; it is hardly necessary to really abstract the paper; but I will ask him to start the discussion on the subject.

Six Reasons for Industrial Electric Heating Development

A. E. Holloway: Chairman and gentlemen—In discussing industrial heating, there are just two points which I want to bring out at this time. I believe we will agree that the industrial heating field offers great opportunity for increasing station load, but it is probably the most difficult field to develop.

In this paper I have given six reasons why it is very difficult to develop. The first point which I want to bring out at this time is the fact that each installation is an individual problem and must have individual attention from



Forty Thousand Eggs in a Single Hatch Accomplished Electrically in California

the central station salesman. The power companies have not had the men nor the time to give industrial heating the attention that it requires, because it is very slow to develop. The power salesman is probably the man who is most in touch with the industrial end, and it is my opinion that, in developing the heating field, the power salesman should be the man to start it; that is, he should look among his power customers to find any cases where he can apply electric heating to an advantage.

It is necessary that the power salesman give each installation careful study, as he must be thoroughly sure in his own mind that what he recommends will be successful. If he makes an error in a recommendation, it no doubt will do more harm to the industrial heating than if he had not made such recommendation.

The second point I want to bring out is the impossibility of standardizing apparatus or devices. A device successfully operated under one kind of work may not be applicable to the same kind for a similar manufactured product in another establishment, due to difference in size, degree of heat, etc. We have a few standard articles made by the manufacturers which we can promote at this time, but as a general thing, the industrial heating does not lend itself very well to standard apparatus, and it is necessary that the salesman of industrial heating be familiar with making installations of this kind.

Along this line, I would suggest that the power companies could do a great deal of good by giving as much publicity as possible to each installation they put in. This publicity should not be general but it should be a detailed description of the construction of the apparatus, the size of the heating elements, the amount of heat required, and the amount of work done,—depending on the kind of an installation. I think each power company could do good work in giving to other power companies the results of their work on these problems so that each power company would not be required to cover the same field and work this out again.

The electric bake ovens in many cities are proving to be very successful, and I understand they are even getting electric baking at a very good rate for the simple reason that they get better results because they get the proper heat. I believe there are some here who are familiar with electric bake ovens and the installation of them, and I would like to hear from them during this discussion.

Chairman: There is no doubt on the part of any one who has given the subject any study, that the industrial heating load, which the central stations have not developed at the present time to any extent, is a big thing for the future. With the exception of a few furnaces, a few bake ovens and a few of one-thing-and-another, there are a very small number of really industrial heating loads on central station lines. I do not know what the reason for that is; probably because it is something that is rather new and requires more study. In addition to the thoughts already brought out by Mr. Holloway, I want to digress a little to the electric vehicle line. It is not an industrial heating load, but it comes, you might say, in a class of industrial uses of electricity, and also we ought to have some discussion on the subject of electrochemistry. On the Pacific Coast we are hearing a good deal now of the electro-chemical business, some of the companies having some installations that are working out quite successfully. We are having a good many applications. This class of business seems to require a very low power rate. I would like to see the discussion started on this general subject of industrial applications, we might say, of electricity, rather than confine it purely to the industrial heating.

Electric Drying, Humidity Controlled

W. S. Leffler: Before passing from the discussion on electric heating, I would like to mention the development of a new type of electrical load which is so closely related to electric heating that it might well be called the brother of the industrial heating load. This is the electric drying or humidity maintenance load. That is, I distinguish between electric heating, thermally controlled, which has just been discussed, and electric drying, humidity controlled, which I wish to bring to your consideration.

Relative humidity, we recall, means the relative quantity of moisture which the atmosphere holds suspended at the different temperatures. Practically, we think of relative humidity as relative dryness. That is, the relative drying effectiveness of the air we may be using to extract moisture from the products we wish to dry.

The humidity control is effected by the operation of an electric hygrostat or humostat, which, as the name implies, consists of an electric control which is sensitive to the changes in the dryness of the air, just as a thermostat is sensitive to the changes in temperature. The hygrostat, once set to maintain a constant dryness, will then alternately divert the electric energy to the heating coils as the humidity increases, and to an electrically heated vapor-producing bath as the humidity decreases below the predetermined point at which the apparatus has been set.

The field of application of humidity control apparatus available to profitable central station exploitation is divided into two classes of work. First, purely drying problems, such as box drying, match tinder preparation, model and papier-mache drying, fruit, herb and vegetable dehydrating, and, in short, all present industrial heating applications where the problem is one of drying instead of heating or cooking; and secondly, humidity maintenance applications, such as is necessary in all color press rooms, tanneries, tobacco and herb-storing rooms, tea, coffee and spice storage lofts, and all industrial processes where rapid changes in the dampness of the atmosphere reduce the uniformity and quality of the product produced.

As a specific example of an application which would fall under the first classification, namely, a purely drying problem, I might briefly mention an installation of 40 kw. connected load which has recently been installed in the California Hawaiian Sugar Refinery's box-drying room at Crockett. The problem was one of drying the boxes in which powdered sugar was shipped from San Francisco to New York. If the boxes were dried too quickly, that is, exposed to air the humidity of which was too low, the boxes cracked and warped, rendering them useless for shipment of the finely powdered sugar. On the other hand, if the boxes were not sufficiently dried before being filled with powdered sugar, the sugar would absorb the moisture from the boxes and crystallize to a solid block, unmarketable upon arrival at its destination. In this application, that humidity which would dry boxes thoroughly and yet not too rapidly was finally determined, and the humostats set at this point (55 per cent humidity) automatically maintain, with phenomenal accuracy, the relative dryness of the air in the drying room, irrespective of outside atmosphere and weather conditions.

This installation, which has been operating for the past six months, has operated at a load factor of practically 80 per cent, based on connected load, which immediately establishes this business in terms of its value to the central station.

As an example of the second class, or humidity maintenance applications, I might mention the apparatus which is under construction for installation in a leather curing room of a large tannery. In this particular application it was found that every time the north wind blew, which meant that every time the humidity dropped below a certain point, the value of the hides tanned that day (some 1100 in number) decreased in value 70 cents per hide, which to the industrial engineer indicated that here was an available revenue varying from $70 to $100 a day which some central station could reclaim by the installation of humidity control apparatus if the latter could maintain a constant humidity irrespective of the rapid changes in atmospheric conditions caused by the prevailing north winds.

Accurate humidity maintenance is of even greater importance in every color press room, for in color press work we find that paper, being far more sensitive to humidity than to temperature, expands or contracts to such an extent under even a 10 or 15 per cent variation of humidity, that it is not possible to make the several colors mesh unless the humidity is maintained to an accuracy of some 4 or 5 per cent.

The economy effected by the humidity control as compared to the old method of attempting to regulate humidity through the agency of a complicated series of temperature controls, at once manifests itself when we consider that on many cold, dry days the atmospheric humidity is sufficiently low to effect the necessary drying operations without the addition of any artificial heat, whereas the temperature control on a cold, dry day would operate the heating apparatus at full heat. On the other hand, on a hot, sticky day the humidity control will continue to introduce the artificial heat until the desired relative dryness is secured, irrespective of the high temperature which may be reached before the high natural humidity is overcome and the proper dryness reached. This means that, irrespective of weather conditions, the humidity control will always produce a uniform product at a perfectly uniform rate of production, which it is at once appreciated is the first essential to the success of any industrial application.

From the standpoint of the central station I do not hesitate to say that the field of application of humidity control apparatus available to profitable central station exploitation is as broad as the present field of refrigeration. The load characteristics produced by humidity control apparatus are, as has been indicated, just as desirable to the central station as the refrigerating loads, and the important point which I wish to make in concluding is that the value of the service rendered the consumer is so great that the present forms of power rates readily apply to this class of work, and it is therefore not necessary to develop an abnormally low rate in order to secure this most desirable class of business.

Chairman: This question of humidity control which Mr. Leffler mentions, detailing a number of installations that would be practicable, entirely left out the subject of the comfort of the people. Anyone who has been in a crowded church or theatre, with his head nodding, can realize there are possibilities for this humidity control where the comfort of the people is concerned, in addition to the purely commercial aspect of it.

G. B. McLean: Mr. Leffler, do I understand this humidity control is brought about by some other means than raising the temperature?

W. S. Leffler: No sir—if I may answer that, Mr. Walton. The humidity maintenance is effected by increasing the temperature of the air to a point where it retains suspended in it a greater quantity of water vapor and therefore extracts from the product to be dried the necessary quantity of moisture; but, on the other hand, as I have stated, when the humidity is too low, the control introduces water vapor through the agency of an electrically heated water bath.

G. B. McLean: Well, it is purely an electric heating proposition.

W. S. Leffler: Yes, Mr. McLean, an electric heating proposition, humidity controlled, however, and not temperature controlled.

Chairman: The circulation has a great deal to do with it also.

W. S. Leffler: Yes, the artificial circulation, motor driven, in some cases consumes an additional quantity of energy, which further increases the value of the resultant load characteristic to the central station.

H. S. Batchelder: As Mr. Leffler has brought this question up, I have a concrete instance of the Sperry flour and the Balfour-Guthrie people having considerable trouble, when wheat comes to the mill, due to moisture in the bags. It affects the weight and the quality of the wheat in some way. Would an application of that kind fit this installation, Mr. Leffler?

W. S. Leffler: It would, indeed, Mr. Batchelder. In fact, that is another one of the applications which further broadens the field, together with Mr. Walton's suggestion.

Electric Furnaces

Chairman: There are a number of other angles to the industrial uses of electricity that we have not touched. Mr. Kahn of Stockton has the reputation of having on his lines in Stockton more electric furnaces than all the other lines in California. Mr. Kahn, we would like to ask you to tell about the electric furnace situation as you see it from your installations in Stockton.

Samuel Kahn: We are serving two electric furnaces for the production of steel castings. One is a one-ton furnace; the other is a three-quarter ton furnace. In serving these furnaces we do not attempt to take care of them over our local distribution system, but build special substations for each installation, taking the energy at 60,000 volts and transforming it down to 2300 volts in one instance and 11,000 in the other. The furnace comes equipped with special transformers which reduce the voltage again to about 100 volts. These furnaces are a difficult load to handle until you become acquainted with their operation,—not alone you, but the people who have them installed. Because of the nature of the load, in their initial operation you throw "dead shorts" on your system several times a day. Electric furnaces are built in single-phase types, two-phase and three-phase. We discourage anything but a three-phase furnace, so that we will have no unbalanced condition on our system. Now, an unbalanced condition does not make so very much difference on a furnace you get in the larger sizes, it might make a material difference unless your system is sufficiently large to take care of the varying loads.

The Iron Smelter at Heroult, California, with 2400 kw. Capacity, 20 Tons per Day

We have recently entered into a contract, to become effective several months hence, for electrical energy to supply a 6-ton furnace. This will require 2000 horsepower. And you gentlemen can readily appreciate that a 2000 horsepower single-phase furnace would create a most unsatisfactory condition of unbalancing if a dead short were to occur, for in such event the demand increases from 300 to 400 per cent above normal.

The function of the electric furnace, as I stated before, is to produce steel castings. Heretofore, in Stockton, they have been producing them by means of crucible processes, but on account of the increased cost of materials, epecially the crucibles, electricity at 1 cent per kilowatt hour will produce castings for about 50 per cent of the present cost of crucible steel castings made under the old processes.

I cannot think of any further general remarks I would like to say, Mr. Chairman, on electric furnaces. I do want to say something about the commercial section, if you will allow me about two minutes.

Chairman: Yes, sir.

Samuel Kahn: It occurs to me that the commercial section of the National Electric Light Association is at this time the most important section. We are divided into four general classes, you might say, the engineering section, which takes care of production, another class of the engineering which takes care of distribution, an auditing section, and a commercial section. The commercial section is the one that meets the general public and has its peculiar problems to solve. The other three sections have, of course, their problems, and many of them are difficult, but they are problems which we can solve within our own circle.

The commercial section has to meet the public, has to convince them of the extraordinary uses of electricity, and th superior application of electric processes, and I think that no one of us can devote too much time or give too constant attention to the various applications of electricity and their various uses to the public in general. The field is becoming broader all the time, and these meetings are especially valuable when we can come here and let this meeting act as a clearing house, as it were, of our various ideas and our various applications.

Ed. Whaley: Can you tell me what is the load factor you get on that electric furnace on an annual basis?

Samuel Kahn: That is a difficult question to answer. Our experience with electric furnaces has been limited to some six or seven months. The load factor, I should say, for the first few months of operation, has been in the neighborhood of 25 per cent. The foundries that have these furnaces installed, however, are building up constant business—and some of them are now running seventeen hours a day and hope to run 24 hours a day. If a furnace would run 24 hours a day, it would not mean it would be in actual operation 24 hours, because there would probably be four hours out of those 24 hours you would be charging the furnace and tending to minor details in connection with the operation of the furnaces. I would say the maximum load factor under the best conditions you can get out of the furnaces would be in the neighborhood of 70 per cent.

Mr. Crane: What is the power factor of the furnaces you have? What is the rate upon which you get the business?

Samuel Kahn: We make a straight rate of one cent per kilowatt hour, delivered at 2300 volts, or higher. The power factor in first starting sometimes drops as low as 50 per cent. I would say an average power factor would be up around 80 per cent. Those are approximate figures, subject to correction, because we have not been operating long enough to know what an average power factor would be. These furnaces are good revenue producers. The three-quarter ton furnace we have installed brings in a revenue of $700 a month, and the one-ton furnace brings in $800 a month.

Chairman: What capacity in kilowatts is the three-quarter and what is the one-ton?

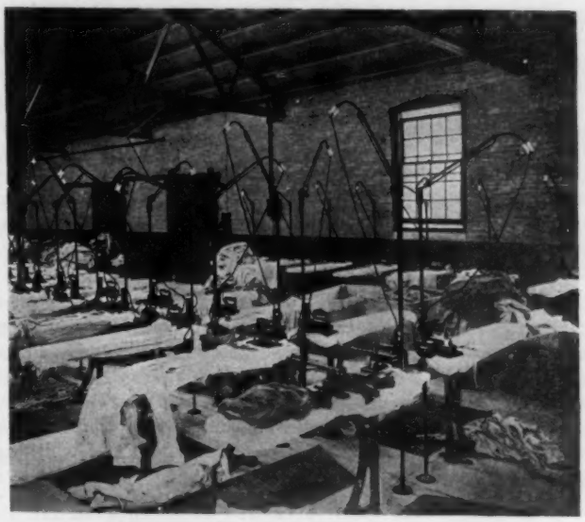
Samuel Kahn: The one-ton furnace is supposed to take 250 kw., and the three-quarter 175 kw. The six-ton furnace we will serve will probably bring us a gross revenue of $60,000 a year.

Chairman: I might add in connection with that that he referred to kilowatts, and we must not forget that in taking care of this kind of service we must take care of the k.v.a.

Mr. Crane: I would like to ask Mr. Kahn if, in the rate, any consideration is taken of the power factor, if the power factor is made a function of the rate in any way?

Samuel Kahn: No. The power factor is not given any consideration, whatever, in making the rate. In making this rate it is like making rates for other applications of electricity, you have to make a rate that will get the business. And in making your contract, you can't lay too much stress on power factor, load factor, voltage variations, and the like, because a foundryman is not interested in that; he is interested in producing steel castings at the lowest possible cost, without any bother of the different electrical terms which might enter into a theoretically perfect contract.

Chairman: I think those who heard the rate discussion yesterday will agree right away with Mr. Kahn's brief words that we make the rates to get the business.



Typical Commercial Laundry Load, illustrating the Enormous Possibilities of Industrial Electrical Heating

W. M. McKnight: I have two electric furnaces in my district. One of them has just been installed and put in operation; the other one has been operating three years and is turning out four and five heats a day from 2:00 a. m. to 5:00 p. m. and has a monthly consumption of 150,000 kw.-hr. at present. The original installation was a Stassano furnace of one ton capacity with an energy demand of 300 kw. This furnace did not operate economically and was displaced by the present two-ton Heroult type. The energy is furnished through two 250 k.v.a. transformers, supplied from a 10,000 volt transmission line; this line supplying no other load because the furnace interferes with the line regulation. The power factor is good, but the load factor is poor. This is not given serious consideration in fixing the rates, because of the large kilowatt hours consumption and off peak load.

The furnace is charged with cold metal and the electrodes work down through the mass and when this caves in it short circuits the furnace and puts a big jog on the line. This is the reason this plant has an independent transmission line direct from the substation.

The second furnace will be supplied through three 250 k.v.a. transformers and will be a four ton furnace and will be charged with hot metal from the open hearth furnaces and will be a fine load. This is also a Heroult type furnace.

Mr. Kahn touched on one point that I have had in mind for quite a long time, that I wish to say a word on, and that is the matter of rates. Salesmen should not impress upon the consumer that he is selling electricity, but is selling service, and the service is more important than the rate. We ought not to have any rates for energy to sell. We ought to sell service. Let the engineers fix the rates and we will just sell service.

It seems to me that the time is coming when every house, every suburban home we will say, will return to the central stations a revenue of ten dollars per month for service rendered, not electric energy sold. There is no reason why every home should not give us this revenue, and as our friend from Johns-Manville Company said, "they can put on a very efficient covering for their hot water boiler, but I assure you that if he will go a step further and supply the lagging with a good pink cover to match the ladies' dress, he will satisfy the consumer with service and she will pay the ten dollars revenue we want and get the service." (Applause.)

Chairman: I would like to ask Mr. Butte of the Butte Engineering Company of San Francisco, a contractor, to talk on this.

C. F. Butte: I notice Mr. Kahn stated he had considerable trouble in the short circuiting of the furnaces. I don't know who installed the Stockton furnace, but the way the furnace people furnish the equipment for the furnace, I don't wonder he has trouble with his line. The Pacific Gas & Electric Company has not had any trouble on their line since the furnace has been in operation, merely through the insertion of auxiliary apparatus and not depending on the breaking of the primary circuits, thereby preventing short circuits in the furnace that is installed. The transformer capacity is 300 kilowatts and the furnace is in operation 24 hours a day. It is working very satisfactorily from the furnace standpoint, but the people are experimenting, and they are having a little metallurgical trouble, which they expect to overcome.

And for Mr. Walton's information, another one is going in. The rate in this particular installation has not been established. They are awaiting developments and tests. I presume the power company will establish a rate very shortly.

In regard to the further application of heating, the match industry has awakened to the fact that the electrical process of drying their tinder instead of the steam is more economical. The Diamond Match Company, and another match company near Berkeley, have one equipment in operation and expect shortly to convert their entire steam drying processes; it has proven very satisfactory.

For the information of companies in the mining districts, the application of the electric relay heating in the air compressor lines may be of interest. At certain periods of the year some of the mines in Alaska could not operate until recently, for the reason that the air would cool off in their lines and the pressure would be so low at the hammer or the drill that they had to shut down. Merely through the insertion of heaters in the air line in relays of four to six hundred feet, and heating the air as it passes through the pipe, permits them to continue the operation in any kind of weather.

There is another application the power companies may be interested in, that is entering into refrigerating machinery, of raising the temperature of the mixture to a certain point as it comes through—I don't know the exact process, but we raise it from, I think it is, 22 to 36, presumably on the humidity process that we have heard from before.

But the electric furnace is something I think we all should watch very carefully and help along. We contractors come in touch with the consumers of the power companies and it is up to us to help this along, and we help them every opportunity we can get. We are depending upon the services and their connection, and for that reason we always help the power companies along in increasing the loads, incidentally increasing and expanding our own business. We are selfish in our motives, but we are generous in our method.

John Crawford, Jr.: What are they manufacturing in this business on the Pacific Coast, using an electric furnace?

C. F. Butte: It is a foundry and they are endeavoring to take nails, or any old scraps, and turn them into pig iron for casting work, bringing the material down for cast iron work.

They have been somewhat successful with their last lot. They are running 24 hours. And incidentally, for the information of the commercial men in case they have any other shorts on their furnaces, there is in development, an automatic control of the arcs so we will not have to have a man standing at the furnace all day long feeding the arc and creating the short circuits that were mentioned, because the short circuits not only occur, as Mr. Kahn explains, just through the carelessness of the operator, it is in the feeding of the arc that we become careless at times and bring them together.

Electric Enameling Ovens

Chairman: There is another angle of the industrial heating situation that we have not touched on in the discussion. That is in the enameling ovens for baking the enamel on automobiles. There are two or thre manufacturers' representatives in the room who, I think, could discuss that and point out at least the volume of business of that sort that is at hand.

W. L. Boxall: We have in Los Angeles quite a large unit in the Ford assembling room, and I think I see Mr. Carr of the General Electric Company here and I believe he can give you a great many interesting details, if you wish to have them, in regard to that oven.

While I am on my feet, I would like to mention another use for electric heating, and that is the decrystallization of iron or steel. We have a plant on our system where they use the electric heat for heating up the oil well drilling pipe and they find it effects a great saving by their being able to use pipe over and over again that they would otherwise have to throw away for fear of crystallization. They also find that it is only the alternating current that will do that work; direct current of the same amperes would not decrystallize the pipe as well as the alternating. The power factor on that, I believe, runs about 40 per cent; it is about 300 kilowatts connected load, single-phase, in the experimental plant, and this looks as if the process is going to be commercially successful, in fact is now operating commercially.

C. T. Carr: There was a reason for the electric enameling ovens due to the high temperature which the Ford people found necessary to enamel their parts, and in using gas for generating heat they found that they had lots of explosions. Furthermore, unit cost is lower.

Mr. Leffler: While you are on the subject of automobile drying, may I ask, have you any information with reference to the success of it being applied to the acceleration of drying paints and varnishes having a turpentine base?

C. T. Carr: No, I have not.

Mr. Leffler: I have been recently conducting a series of experiments, using the application of ozone to accelerate the drying of turpentine base paints and varnishes. It normally takes varnish from two to three hours to set, but will set if exposed to ozone, in from 15 to 20 minutes' time. Of course, the electric load from the ozonator is practically negligible, but if the ozonator will increase the speed at which the paints dry, or if it will enable the drying temperature to be reduced, then electric heating can certainly be applied economically against any competing form of fuel heating.

C. T. Carr: I think that is a mighty good idea, because that is all that this drying business is, oxidation. If you can hurry it up a little bit, that cuts down the unit cost again and makes electricity more attractive.

W. S. Leffler: It is solely a question of ozonation. Have you any information upon that?

Chairman: No. Your question will go in the record, and if anybody knows about it, they will undoubtedly communicate with you.

C. F. Butte: Mr. Chairman, I am somewhat interested in the decrystallization of pipe. Did you get any information on what the current consumption per length of pipe was, or the current required, and whether it is actually successful?

Chairman: I suggest, Mr. Butte, for details like that, you will get better results by taking it up direct with Mr. Boxall.

Miscellaneous Industrial Applications

Chairman: I think we all realize that the question of industrial appliances of electricity, particularly for heating, are wide and important, both from the central station point of view and the point of view of the distributors of electrical goods. I was pleased to have Mr. Kahn say that the N. E. L. A. commercial section, or the commercial committee, shou'd be the clearing house for information of this kind as between companies and between manufacturers and companies. That is exactly, Mr. Kahn, what we are trying to make our commercial committee. We have made our recommendation to the executive committee, and as you are on that body, I hope you will try, when the question comes up, to make the commercial committee of permanent benefit to the whole industry. Did you want to say anything further on that point, Mr. Kahn?

Samuel Kahn: I haven't anything to say on that particular point, Mr. Chairman, although I fully agree with the remarks you have just made. However, I would like to make a recommendation, and would incorporate it in a resolution, if it is agreeable to this body, that at our next convention we endeavor to have at least one full day of discussion of topics of peculiar interest to the commercial section, and we will try to devote that day exclusively to those topics and not try to combine that with something else. I make a motion to that effect, Mr. Chairman.

Chairman: Mr. Kahn makes a motion that it is the sense of this meeting, the meeting of the commercial section of the Pacific Coast Section of the N. E. L. A., that at the next convention we have at least one entire day for the discussion of practical commercial subjects.

(The motion was duly seconded and passed.)

Mr. Mulgrew: Is any development, so far as any one here can say in electrical incinerators for crematories?

Chairman: Has there been any experience among the member companies with electrical incineration in crematories? I believe Mr. Furniss of the Pacific Gas & Electric Company at Oakland could tell us of an experiment we tried that did not work out successfully.

George B. Furniss: The crematory in Oakland undertook to follow the experiments conducted in the north, but on account of local costs and lack of faith in the appliance, the installation was changed to gas and fuel oil. The manufacturer refused to guarantee it, which seems to be characteristic. I say this with little restraint, as some manufacturers in putting out an appliance refuse to guarantee, yet will say, "In case the unit burns out we will replace it," but still at the same time won't say, "We guarantee to do it." Through lack of full guarantee, the local people hesitated to make further expenditures and resorted to oil and gas.

Chairman: Mr. Holloway, do you wish to say anything further in conclusion on the subject of industrial heating?

A. E. Holloway: I haven't anything further to say at this time, except to comment that most of this discussion has been on large installations. I believe we should not forget that there is a great field in smaller installations and small loads. I have tried to bring that out in my paper, and believe we should not only look to the large loads for building up our industrial heating, but to the smaller installations as well.

Chairman: I would offer the suggestion that those who are interested in the subject of industrial heating, in order to start out with the spirit of our meeting, communicate with the secretary's office as soon as you conveniently can, or when the spirit moves, telling of your own experiences in the various branches, and asking for information on any subjects that you wish information on. The secretary will then communicate with member companies to obtain this information. That will make the organization really useful.

ELECTRICAL PROBLEMS PECULIAR TO THE WEST

(Standardization of transformers, design of distribution systems, general safety orders for highway crossings, field testing of insulators, inductive interference, standardization of hardware, and a discussion of turbines for high head utilization are some of the electrical problems peculiar to the West. In this section of the country irrigation loads must be economically handled and large quantities of hydro-electric energies successfully transmitted over long distances at high voltages. Here is a timely discussion of many of these problems by a number of prominent electrical engineers which marks a distinct advance in electric distribution and design for the future. This discussion is taken from the stenographic report of the engineering section at the convention of the Pacific Coast Section N. E. L. A., Riverside, April 19-21, 1917.—The Editor.)

President R. H. Ballard: The subjects this committee has to handle are of the utmost importance to the industry and particularly to all operating under our Pacific Coast conditions. We have a thought that in this Pacific Coast section the engineering committee will be a strong-arm help to us. The next administration may find it advisable to permit this committee to continue research work which should prove of great benefit to us on the Coast. We have been fortunate in having as chairman of the committee one who has devoted a great deal of time to the subject, and who has now rounded out a program for your consideration. I have great pleasure in introducing to you at this time Mr. J. E. Woodbridge, chairman of the engineering committee, who will take charge of this meeting.

Enumeration of Peculiar Problems

Chairman J. E. Woodbridge: President Ballard, and fellow members of the Pacific Coast section: In your instructions at the time of the appointment of the engineering committee you, President Ballard, directed us to make a general survey of the engineering situation, with recommendations for future work. Not wishing to lay out a program for our successors that may be appointed on this committee, we have not followed those instructions precisely, but, so far as the future is concerned, we have already started several things that we could not finish, as will appear in the course of this discussion.

Before reviewing the engineering committee's work, I wish to make a parallel statement to that made yesterday by Mr. Walton in his opening remarks, in which he said that the selling end is of the utmost importance to the central station business. While it is true that if there was no power sold no engineering would be required, it is equally true that if there was no engineering in the central station business there would be nothing to sell; and I submit with the modesty that usually accompanies engineers' statements, that the engineering and sales ends are equally important.

Before the engineering committee was appo'nted and, in fact, before the Pacific Coast section was formed, the Apparatus Committee of the national body had undertaken to standardize the sizes, taps and other features of distribution transformers. Mr. S. J. Lisberger of the Pacific Gas and Electric Company was a member of that committee. He took the matter up with us at the time this committee was formed, and it became evident that it was rather difficult from this distance to express our needs with sufficient force before the Eastern committee. We therefore reviewed the situation, made our recommendations and Mr. Lisberger was sent East to voice our ideas there. The Apparatus Committee acted on and incorporated most of our suggestions and ideas, some of which were original with this section, and our representative was successful in getting standards that will be satisfactory in our work. You will hear later from Mr. Lisberger on this po'nt.

One of the undertakings that we started and have not been able to finish is as follows: Shortly after the committee was appointed we found that the California State Railroad Commission proposed to revise its general order covering overhead line construction, to amplify the same, and make it constitute a complete safety code. We offered the engineers of the Commission our assistance in this matter and this offer was accepted by the engineering department of the commission.

Another piece of work that we have started and have not been able to finish is the investigation of the deterioration of porcelain insulators, particularly of the suspension type. Considerable work along this line has been done by some of our engineers under the instructions of and with the assistance of Prof. Ryan of Stanford University and with the equipment of the high tension laboratories of the University placed at our disposal.

Another piece of work that is not as yet finished is the investigation carried on by engineers (including some of us) appointed by the California State Railroad Commission some four years ago to review and draw up rules on inductive interference. The Joint Committee on Inductive Interference is now engaged in drafting its final report to the commission. I say final. It is intended to be the final report of that committee, but it is not intended or expected to be final in any respect in the matter of evaluating all the elements involved in inductive interference. While we have been at it four years, such work will probably continue for several times that period before the investigation of inductive interference is brought to a basis of practice that will approach a standard.

Your Engineering Committee also set out to avoid a bad situation in connection with suspension insulators, which have been in the past fitted with various sizes of interconnecting hardware, many of which are not interconnectable with each other. We appointed Mr. Klauber a sub-committee of one to recommend a standard. Mr. Klauber has prepared a paper on the subject which has been published in our proceedings outlining the standard which he found had already been adopted by the manufacturers, and commenting thereon.

In the matter of prime movers we felt some diffidence in that other geographical sections have prime movers of much greater size and more highly developed than anything we need in this territory. I am speaking now of steam turbines. We, however, use water wheels to a very considerable extent, generally of the impulse type, and some of our companies have recently developed new plants with very high head turbine wheels. Among these companies is the Pacific Gas & Electric Company, and Mr. Jollyman has prepared a paper on this subject which has been published and will be open for discussion.

We have all become more and more interested in joint pole construction which we are using to a certain extent in the cities of this territory, but which apparently is now becoming advisable even in rural territory. At our request Mr. McDonald, secretary of the Joint Pole Committee of Los Angeles, has prepared a paper which has been published on this subject.

One of the most perplexing problems of the small as well as the large companies is the protection by fuse or otherwise of distribution transformers. Among our papers is a series of articles on this subject, concerning which there are many diverse views that may be brought out in its discussion.

Our use of steam turbines is usually and will be to a greater extent in the future mainly as stand-bys for hydro-electric power. This use is quite different from constant

operation with higher load factors and requires a different organization of the steam plant. We have a paper on this subject by Mr. Morgan of the Pacific Light & Power Corporation, and I know we have many ideas of value in this connection that will be brought forth in its discussion.

I wish to thank the other members of the committee for their cordial co-operation in getting together these papers in the short time that we have been working. I also wish to thank the engineers outside of the committee for their contributions, as we have acted on the principle of the good executive in getting somebody else to do the work in many cases. For example, the sub-committee appointed to assist in the revision of the safety code, consisting of Messrs. Lisberger, Quinn and Cunningham, is made up of men no one of whom is on the main committee.

We will consider first today the subject of standard distribution transformers, on which Mr. Lisberger can give us the main facts of the standards adopted.

Standardization of Transformers

S. J. Lisberger: Mr. Chairman and gentlemen. Engineers intimately connected with the design and operation of distribution systems know well the difficulties encountered in the operation of transformers of different ratios, such as have been manufactured by the several electrical companies.

Several years ago the National Electric Light Association undertook the standardization of voltages of transformers, in order to overcome the difficulties encountered. There existed at that time in the classes most generally used twelve different ratio transformers, where there normally should have been but three classes. That condition was far from ideal for the manufacturer and for the operating companies.

It was realized that the adoption of standards for this type of apparatus would be a great benefit to the manufacturers, as well as to the operating companies, and with this idea in mind the Apparatus Committee of the National Electric Light Association started the work in 1915.

The 1916 Apparatus Committee, of which the writer was a member, undertook the completion of the work and appointed a Western Sub-Committee, in order to obtain the ideas of the western companies. This Western Sub-Committee met early in November, 1916, and after a series of meetings in Los Angeles and San Francisco, the writer went east, appearing before the National Committee in New York in February, 1917, at which time the report (as published in the issue of "Journal of Electricity," June 5, 1917) was formulated.

Chairman Woodbridge: Mr. Lisberger has given us an outline of this work and its results. I want to call attention to one point. It may appear that the transformer that has a range from 5700 to 7200 volts is a complicated transformer. That transformer has only two primary taps, one cutting out 600 volts and the other cutting out 300 volts. You can cut out the 300 or the 600 or both. The range is largely obtained through a corresponding range of secondary voltage.

I believe it would be advantageous to get the views of the manufacturers on this matter. Mr. L. R. Brown, of the transformer sales department of the General Electric Company can tell us something of the advantages to the manufacturer, and as he has been around other parts of the country he has some information as to how other companies will fall in with this standardization.

L. R. Brown: I don't think I have much to add to what Mr. Lisberger has had to say on the subject. The manufacturers, I believe, are very pleased with the action of the National Electric Light Association on this matter. For years 2300 volt transformers had been standardized. Above 2300 every company adopted a standard that best met their conditions or that they thought met their conditions. As a result there has been no quantity manufactured, and practically all high voltage transformers, with the exception of the 6600 class, of the new standards, all lines up to 33000, will be more or less on a quantity basis. Both the manufacturer and the consumer will profit by this quantity manufacture.

Chairman Woodbridge: In this section we are perhaps as much interested in local stocks as we are in the manufacturing problems, and I would like to ask Mr. W. P. L'Hommedieu of the San Francisco office of the Westinghouse Electric Company to tell us how this standardization will affect the local stock situation.

W. P. L'Hommedieu: One of the greatest problems in the distribution of transformers to consumers on the Pacific Coast is that of local stocks, since the manufacturer must be prepared, as far as is practicable, to fill all orders from Pacific Coast stocks. A considerable amount of money is therefore invested in these stocks.

The adoption of the proposed standards will affect this stock situation in two ways, and will benefit both the consumers and the manufacturers. At the present time the requirements of different consumers necessitate carrying in stock more than one line of voltage ratios for a given voltage class of transformer, with the result that stock carried for one consumer cannot be diverted to another.

After the adoption of the new standards, all stock carried will be available for any consumer.

Obviously, this will result in greatly improved service to consumers in promptly filling orders and at the same time will probably reduce the total stock requirements. This will reduce interest charges on stock, which will in turn have its bearing on the cost to the consumer.

C. O. Poole: I was very glad to hear Mr. Brown make the statement that they were including in their standards distribution transformers up to 33,000 volts. I was rather apprehensive that I would be left out in the cold. Mr. Lisberger has not made special mention of voltages of eleven or twelve thousand volts, and I would like to ask if the matter of 15,000 volts and up to 33,000 volts have not been standardized in size as well as voltages. In our district down here we have found it necessary to go a little higher than most other companies in the distribution voltages, owing to the uncertain distance we may be called upon to transmit. We have in our Imperial Valley district a standard distribution of 15,000 volts, normal rating, but our sub-station transformers are wound for 16,500 volts, so that we can take care of our drops for the outlying districts. I want to assure the manufacturers that our company will be very glad to fall into the standards suggested by this committee.

E. R. Northmore: I am glad that Mr. Lisberger brought up the question of three voltage secondaries, i.e., 110, 220, 440, and that a standard has been adopted.

The majority of the distribution transformers purchased by the Los Angeles Gas & Electric Corporation had the three voltage secondaries until the manufacturers made an extra charge for the extra voltage tap. We then made a careful check of all our transformers in service and found that less than one per cent of our transformers required the three voltages.

We now require three voltage secondaries on our larger sizes only, that is, all distributing transformers over 37½ kilowatt have the three voltage secondaries.

P. M. Downing: I have not read the paper that is being discussed this morning, and I do not know to what extent the standardization of equipment is being advocated. Personally, I am in hearty accord with the standardization idea. I think it is a good thing for both manufacturer and user. It should quite materially reduce the cost not only of transformers, but of all equipment because the manufacturers will be called upon to carry fewer types, sizes, voltages, etc. However, there is a possibility of over-standardization.

One speaker has said that by standardizing the manufacturers could reduce the stock they have to carry. On this point I cannot agree with him. My experience for the past few months has been that the manufacturers have not

any stock. We have been trying to get transformers of almost any size, voltage, characteristics, etc., for immediate use, but in most instances we have been advised that there were none in stock, and the best that could be done was several months' delivery.

With this situation confronting us it would seem that right now is the time for the manufacturers to standardize. They can sell anything they can deliver, regardless of size, voltage, etc. If they will stop manufacturing some of the odds and ends, they will find that the central station companies will be very glad to accept anything built according to this proposed new standard.

It is my understanding that th's report advocates standardizing all transformers regardless of size, voltage, etc. That I think is impracticable. On transmission lines you have so many conditions to meet that I think practica'ly every bank of step-up or step-down transformers must be considered special. They must be designed to meet the conditions under which they are to operate; for instance, step-up transformers in a power house a long distance from the distributing center would necessarily have a different ratio of transformation from those at the step-down station at the distributing center. Those at the step-up end of the line need not have the same close regulation that is called for in those at the step-down end. You can always vary the bus voltage in your generating station through a considerable range to compensate for the poor regulation in the step-up transformers, but where you have a large number of step-down stations supplied from the line you cannot change the line voltage to offset the poor regulation of the step-down transformers. Another feature that makes transformers having poor regulation desirable in the generating stations is that they limit the strains thrown on the generating equipment by limiting the ratio of current when line troubles occur. So, as I say, I think the idea of attempting to standardize on all transformers is a mistake. I think the idea is an excellent one, and will result in a great deal of good.

I. B. Potter: I want to ask Mr. Lisberger if there is any provision for standardization of three-phase transformers in the 2300 volt class. That is, from 5 to 100 kilowatt three-phase transformers.

R. E. Cunningham: I should like to ask whether 50 cycle transformers will be special, or to what extent the new 60-cycle transformers can be used on 50-cycle circuits?

Design of Distribution Systems

H. F. Jackson: I would like to make a few remarks. It seems to me that closely allied to this subject of standardization of transformers is the study of the distribution line or distribution system. It has seemed to me that most of our trouble comes from the fact that we have such a wide range of distribution systems. Every company, with its own engineers, is working out a different system. I would like to suggest as bearing directly on this subject and as making the standardization of transformers practicable, that the various companies through their engineers see if we cannot adopt some better standards for distribution systems. For instance, in the rural districts, the question arises, shall we distribute directly from a 16,000 volt line or from an 11,000 volt line, or shall we run to a distribution center from which we will distribute at 2300 or 4000 volts? The tendency has been with our long lines to put a special transformer on to take care of some individual demand that is immediate, and gradually to allow a system to grow up by reason of these frequent individual taps on the supplying lines, so that we finally get, for example, to a 16,000 volt distribution rather than to a 16,000 volt secondary transmission from which to take off the distribution at central points. I mean to say that we are allowing the case of the special individual consumer to control the situation without looking forward enough to see when there will be two or three customers of the class in the same neighborhood and providing for the condition of the future—and not the distant future, but the reasonably near future—by taking care of a central district with a general step-down station to something like 2300 or 4000. Now, if we would all lay out our rural systems so that eventually the high voltage distribution lines will become secondary transmissions, and from those secondary transm'ssions lay out subordinate substations with a network of lower voltage radiating lines, we will save ourselves a lot of trouble in the future. That, in conjunction with the standardization of transformers, will perhaps make the problem of the big city tie in with the problem of the rural districts, which it does not do at the present time. I would like to urge in conjunction with this matter the careful study of the various engineers, of the distribution systems, primary to the fixing of the transformers.

Chairman Woodbridge: Mr. Jackson's remarks outline a good field for future study by the engineering committee. We seem to have two diverging tendencies in that respect. Mr. Poole speaks of distribution at 33,000 volts. Others who have been distributing at one-half that voltage are tending to use such lines as secondary transmissions and with real ditribution at a lower voltage.

S. J. Lisberger: Answering Mr. Cunningham's question regarding the operation of the sixty-cycle standard on the 50 cycle circuits, would advise that the 60 cycle standards will operate satisfactorily at 50 cycles, but with slightly higher losses.

To Mr. Poole's question. The three voltage rating includes the 13,800 volt class, as well as the 2300 volt class, the 6900 volt class and the 11,500 volt class. The 11,500 volt class, the 13,800 volt class and the 16,500, 22,000, 33,000 and 44,000 volt transformers all have two 5 per cent taps on the primary.

With reference to Mr. Downing's discussion, it was realized that the standardization of distribution transformers would be of the greatest benefit. It was hoped, however, that in future work there would be a possibility of standardization of power transformers. The committee realized that many systems would require transformers especially designed but thought that if the voltages were standardized that engineers might make changes in the new system which would allow the use of standard lines, which would result in a lower price, as this standardization tended to materially reduce factory engineering and production costs.

The committee did not undertake in this work a standardization of the three-phase transformer, but that work is to be undertaken by next year's committee. Up to this time, howver, the three-phase transformer has not been used in sufficient quantities to allow production on the quantity basis anywhere near comparable to the single-phase unit. This means that the cost of the three-phase transformer, as compared with the single-phase transformer, warrants careful consideration.

Mr. Jackson's remarks, pertaining to the design of distribution system, are interesting and demand consideration. Distribution systems are one of the most costly parts of our plant, and careful study is absolutely necessary for economic results. Much money can be spent in a distribution system with little to show for the expenditure and unless much care is given to the selection of a proper voltage, with due consideration given to the density of load, economical results will not be obtained. Or expressed in other words, it will often pay to supply a densely congested section at 4000 volts rather than at 11,000 volts, even if it be necessary to build an 11,000 volt line with small outdoor substations, stepping down to 4000 volts.

The taps on the 6900 volt class were designed not only to meet the demands required by the users of this new class, but to provide the taps that would give the same ratios as the existing class; this in order that the new class would bank properly with the existing class.

In closing I wish to call attention to the thought that prevails throughout the report, that the general adoption of

these standards will ultimately result in material economies to the users of this class of apparatus through reduction in manufacturing costs, elimination of many varieties of stock and improvement in deliveries and that it should be further borne in mind that there are many systems where transformer requirements will not conform to the standards listed and that it is not the intention that these recommendations should limit the use of any special transformers, but the specifications herein are the ideal towards which to work in designing new systems, or making changes or additions in existing systems.

General Safety Orders—Highway Crossings

Chairman Woodbridge: The next subject for discussion is the preparation of the General Safety Order. We can say little or nothing about our work on this until it is approved by the Railroad Commission. But I should like to have an outline of the proposed scope of the order from the commission's representative. I had hoped that Mr. F. E. Hoar, gas and electric engineer of the commission would be here, but in the absence of Mr. Hoar I will ask Mr. A. F. Bridge of the same department to give us some remarks on that matter.

A. F. Bridge: Mr. Chairman and gentlemen, at the present time the regulations and laws in this state covering safety of construction are more or less contradictory. They consist of the statute of 1915, known as chapter 600, enacted in 1911 and amended in 1915; the commission's general order No. 26, which covers the matter of clearances and safety of construction at crossings, highways and railroads, and the commission's general order No. 39 (which, while primarily and inductive interference order, also covers the protection of communication lines from contact with power lines at points of close proximity).

The commission has realized for some time the necessity of an order which would consolidate these various safety rules and laws and remove the contradictory portions of them, and, in view of the work done by the Bureau of Standards in evolving a safety code, we felt that the time was opportune to enact a general safety order covering pole line construction. The present rules, so far as I know, do not cover the matter of clearance above ground where lines are constructed on highways. It is obvious that the matter of clearance is just as important where a line is constructed along and over a highway as where it is constructed across it. It is contemplated that this matter shall be covered in this proposed safety order, and we hope to combine the various statutes and orders that are now in effect. In formulating this order we have asked the co-operation of the utilities which will be affected and expect that through informal conferences with engineers representing the various bodies, we can devise something which will be mutually satisfactory. The practice which has been generally adopted in such matters in the past has been for the commission or other regulatory body to draft a set of rules, call a public hearing and ask for comments from the interested parties. In a proceeding of this nature, where the interests of some of the parties tend to be opposed on some points, absolute co-operation and absence of bias is essential to accomplishing any results. To date we have been most successful in that respect, and although the work has not progressed very far as yet, having been started quite recently, before long we should have a safety order which will be acceptable to all of the wire line interests.

Chairman Woodbridge: In a matter of this kind I believe it is advisable to get the views of outside interests, and one of the interests outside of this organization that is affected is the railroad interest. I should like to ask Mr. Fred Geibel of the Southern Pacific Co. to give us his views as to what the general safety order should cover in the matter of railroad crossings. That is, power lines over railroad crossings.

Fred Geibel: We have at the present time two sets of specifications for overhead power line crossings, which conform as nearly as possible to the requirements of the several states through which we operate. There are practically two points to be considered in the construction of an overhead crossing: First, there should be a minimum number of wires over the railroad tracks, signal and dispatching systems; and second, the construction should be not only safe, but so constructed that structures adjacent to the tracks will fall away from the tracks in case of serious failure. Application for crossing agreements originate by the power company filing papers with the division superintendent. These papers with attached specifications and drawings are sent to the general office, San Francisco, for approval. While copies of our standard specifications are in the hands of all of the power companies, many crossings come through without sufficient information. Under such conditions it is necessary to hold up approval of crossings until complete data is received. Some companies have developed standard blank forms which provide space for all necessary detail information. This is a very excellent idea and is recommended for general use, as it insures against omissions of essential data. It is not necessary to show detail construction, but all points covered in the specifications, such as pole top diameters, cross-arming, insulators, size wire, etc., should be indicated. As a suggestion it is recommended that the committee standardize on letter-size for drawings attached to crossing agreements. The letter size is more convenient as the drawings can be easily filed with supporting papers. We are also interested in chapters 499 and 600 and general order 26, as affecting power distribution and trolley line construction. It is understood, however, that the several differences in the requirements of these regulations are now being considered by your committee.

Chairman Woodbridge: One of the objects of this work is to make the sub-committee a general clearing house for the power interests with the engineers of the commission that will draft the code, in order that there will not be a confusing number of criticisms or any conflicting criticisms. In order to carry out this work properly the sub-committee would undoubtedly like suggestions as to proper provisions for the code. It may not be the best time now to give such suggestions, but if anyone has any suggestions we would be glad to hear them.

C. O. Poole: To my mind there is a great need for the standardization of construction of railway and highway crossings. We have found that some of the railroads are rather stringent in their requirements. The Southern Pacific has been quite reasonable in exacting requirements for the strength of construction, etc., but other companies we have found have gone so far that they have more than doubled the size and weight of structure for the crossing, which is very expensive, and sometimes causes delay. Another point is in connection with what is termed highways and highway crossings, which is a pertinent factor in this order which you have under consideration. We had occasion a couple of years ago, where we had a 100-mile transmission line to construct, to make 100 highway crossings. That is to say, they were highway crossings according to the interpretation of the code. Each of these highway crossings would probably cost us $100 more than the ordinary straight away construction would cost. The result was that we were in violation of the code in a great many cases. Some of the "highways" are nothing more than trails. Yet a wagon would probably go over them once a year or once a month. I think, therefore, it is quite important that the definition of what is a highway should be given.

H. F. Jackson: I don't know whether I am always taking exceptions to Mr. Poole's statements or not, but I have had a good deal of experience with this kind of crossings and I think there is no subject where perhaps lack of definite standards and lack of knowledge—that is, in reference to what we should do—has had more force than it has in this question of crossings. It has seemed to me that we have

leaned over backwards by reason of our lack of knowledge of what to do in an attempt to be safe. It is just as important that the crossing of a highway shall be safe as it is that that crossing over a railroad should be safe. It is as important that a line running parallel to a highway, or a line running over a man's farm or his dooryard shall be safe as that it shall be safe on a highway or railroad. I believe th way to do this is to make all of our construction as safe as possible and to use good standard construction over all of these places. Make the standard construction right and put it up in good shape and as far as possible avoid special work for crossings. It is very difficult to say what does and what does not come under the order. It is difficult to say that a trail or a small road is not under the order. We are continually in trouble as to whether the crossing of a man's path shall receive the same consideration as the crossing of an important railway line like the Southern Pacific Company. I do not want to be understood as standing for anything except the safest possible arrangement for any railroad or any important highway, but I do ask that we shall not make too complicated a situation with regard to any of these matters. I believe that the doubling of insulators doubles the hazard. I believe if we put a lot of heavy insulators over the railroad line we are running the risk of doing more damage than good. I would therefore suggest that in considering this matter we consider it on the basis of making the whole line good, and avoiding special construction work. In studying this subject we should study it with a view to the economic as well as to the engineering side, giving both their proper weight, and then we should provide a structure that will be simple and avoid as much special work as possible.

A. H. Babcock: A railroad is supposed to have plenty of all kinds of standards for everything. We have been very glad to follow any standard arrangement on a crossing that will permit us to carry out our obligations to the public which are, in general, to transport people and things safely. It is difficult sometimes to make a power company see the justice and wisdom of certain requirements for a small line, unimportant to them but crossing one of our important tracks. It is difficult to make the power company realize that at such a crossing more protection is required. Interference with our signal system is a very serious matter, let alone the danger to the operators in the telegraph stations. We have had switch boards burned up. We have had stations burned down. We have had apparatus burned out for fifty miles on each side of one crossing simply by the failure of one transmission line. The failure of the signal system produces a stoppage of traffic which becomes serious at once; because a train is called upon to stop when the signal says stop, and it must flag over that block to the next signal if it does not clear within a certain specified time. So there is not only the destruction of expensive apparatus, but also delay to the traveling public. As for the physical hazard, it is as bad to have a telephone line drop down on a man on a box car as a 100,000-volt line. The other day I came out over the Santa Fe line, and as I watched that track from the rear end of the train I saw crossings of transmission lines put up in thorough workmanlike fashion and of a design that I think if my company had insisted on we no longer would have had a prominent power manager get up and call us reasonable. I will be glad to meet in conference to bring about a standardization of crossing designs. The sum and substance of my remarks is directed to the suggestion that we do get together in these matters. Although we are not members of your association, let us come in and let us discuss these things with you and see if we cannot reach a more satisfactory working condition than we have at present.

Chairman Woodbridge: We will now pass on to the next subject, which is porcelain line insulators.

One of our guests at this meeting is Mr. P. M. Lincoln of the Westinghouse Company, who is known to you all, if not personally, by reputation. One of the objects of his visit to the coast is to investigate the insulator situation. It may not be known to all of you that the Westinghouse Company has decided to go into the insulator field. I should like to ask Mr. Lincoln for his views on the insulator question, particularly on the question of improvements in insulators which may avoid deterioration and other difficulties.

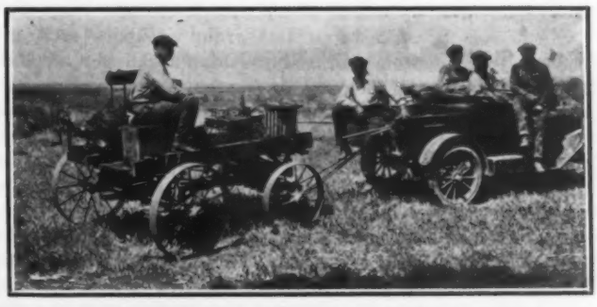
P. M. Lincoln: Concerning this matter of insulators, it is one in which I have been interested for many years. I remember many years ago when I had the duty of conducting Niagara power from Niagara Falls to Buffalo, that though that line was built in 1896 with only 10,000 volts, I am satisfied we had more difficulties with insulators than anyone would ever think of having on a 150,000 volt line today. We were obliged to take down the first insulators and we put 40,000 through tests, and my recollection is that we got two good ones out of the lot. But that is just an incident.

Now, this question of porcelain insulators is a very important one. One of your engineers on the Pacific Coast said to me last year that he considered the question of insulators on high tension lines to be the most important one before the electrical engineers today. That is a rather broad statement, but it comes pretty nearly being the truth. There was a time when we thought that porcelain when it was properly made would "stay put" forever. But things have come up within the last few years which cause us to doubt that. What is it that is going on in our porcelain insulator? I will confess that I don't know. And it is with a view of looking into that very question of what is the matter with our insulators and what we can do to improve them that the Westinghouse Company has decided to make some investigations. The question, we believe, is to a considerable extent a ceramic one—the question of the manufacture of the porcelain itself. For that reason we have decided to bring out a man who is familiar with the manufacture of porcelain and let him study the question on the ground. You gentlemen out here on the Pacific Coast probably have had more experience in the matter of high tension transmissions than any other section of the country, and we believe, therefore, that this is the place to study the question. We expect to have a man out here who will spend several months in the field seeing if we cannot solve the problem. He will study, so far as he can, in conjunction with those who are already studying this question here, and will study it with peculiar knowledge of his own, in that he is familiar with the ceramic side of the question. We hope that the studies of this man will bring something out. If he does not bring out something it will not be for lack of effort on our part.

Field Testing of Insulators

Chairman Woodbridge: Professor Sorenson of Throop College of Technology has developed a method of field testing for defective insulators apparently superior to the methods previously used, which method has been extensively used on the system of the Pacific Light & Power Corporation. I should like to ask Professor R. W. Sorenson to tell us about the organization of that work, and, if the members want it, about the details of the apparatus.

Prof. R. W. Sorenson: The porcelain insulator problem



The Field Testing Outfit in Transit

consists of two parts, (a) getting good insulators; (b) eliminating poor ones from the lines before they cause trouble. I will dismiss the first by the statement that there is no satisfactory porcelain insulator of the suspension type, as evidenced by the fact that insulators which have been in service on lines for 2½ to 3 years show in some cases as high as 30 per cent loss in that time, the average loss on the lines so far tested being about 18.5 per cent for the three years.

With this loss there must be some method of eliminating bad units before they cause trouble. On the particular lines which have been completely overhauled we found the oscillator test to be the most satisfactory, it being more certain than the megger, and more convenient than the high potential test at normal frequency. Also the oscillator test has the advantage of being safe to handle because no harm is done an operator who may receive a shock from it, which, of course, is not true of the normal frequency high voltage used for that test.

Testing Insulators

The value of the elimination of bad insulators from lines is shown by the fact that the three lines overhauled on which there is a total of about 30,000 units, have not been subject to a single shut down during the wet season just passed, a record not previously attained.

The oscillators used for this work were constructed in the shops of the Pacific Light & Power Corporation upon my recommendation. They have been satisfactory both for use on the ground and on the tower lines as illustrated by the accompanying photographs.

While the high frequency method of test has been so satisfactory in this case, it is not on the basis of present knowledge advisable to say that it is the one method of test for all conditions for it may be that some conditions will be encountered when other methods of test will be more suitable.

In fact as in every important undertaking it has been the group of men or the organization doing the work and not the apparatus that is responsible for the success of the campaign to eliminate the bad units on the lines giving trouble.

The method of procedure of the men doing the work was as follows: A test station was established at San Bernardino and tests were made on a large number of suspension insulators taken down from a line 26 miles long which had been operating at 15,000 volts with 3 units per suspension and 4 units per dead end.

The first group of these insulators was given 4 tests, megger, high frequency, induction coil, and high potential at 50 cycles.

The results of tests on this group of about 1000 units showed the induction coil and the high frequency oscillator tests to be twice as effective in eliminating bad units as was the megger, that is about double the number of units were found defective by the induction coil or oscillator as were found by the megger. The results of comparison between induction coil and oscillator showed no advantage for either as to effectiveness of test.

A few more units, about 1 per cent additional was eliminated after a few seconds' application of the 50 cycle high potential test just under arc over voltage. This was taken as an indication that we were not over testing with the other methods, and also furnished the basis for concluding that low frequency high potential tests were not necessary. Further tests bore out this conclusion.

All these lines are wood pole lines with ground strips on the cross arms connected to the insulator supports.

At the present time tests are being conducted on the 150,000 volt line of the Pacific Light & Power Corporation, running from Big Creek to the Eagle Rock substation near Los Angeles. This is a steel tower line with 9 units in series in suspensions and 11 units in the dead end strings. The investigation on this line up to the present time shows a much lower loss than encountered on the other lines, the megger eliminating a little less than 2 per cent as defective and the oscillator picking out about 3.5 per cent as defective, with one spot showing as many as 14 per cent of defects.

As to the oscillator, its cost is low, the resonator part weighs about 60 lbs. and can be pulled to the top of a tower so that all the energy is not radiated from leads running to the insulator as would be the case with the oscillator on the ground.

Later on much difficulty was experienced in attempting to use the megger because of moisture which collected on the

The three lines tested traverse a total distance of about

The three lines tested traversed a total distance of about 92 miles and have approximately 27,000 suspension units in service on them.

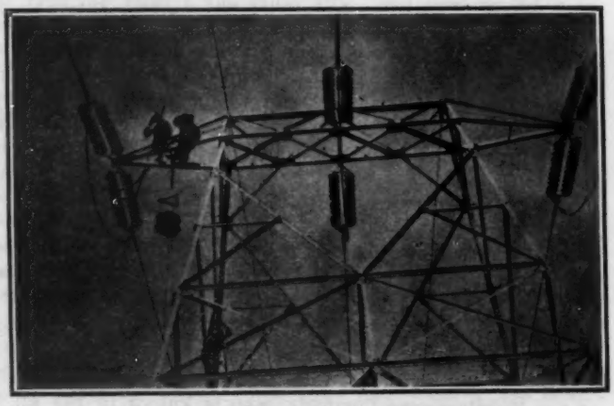
The lines had at the time of these tests been in service about three years and previous to the making of the tests had been meggered each year. This meggering process had eliminated about 8 per cent of the units as bad. The more vigorous tests of this year took out 10.5 per cent additional on one part of the line and 13 per cent additional on another part, making the total loss of insulators during the three years of operation about 19 per cent of the number on the lines.

The defective units were not evenly distributed over the lines, some districts showing as few as 2½ to 3 per cent defective and other districts showing places with over 40 per cent defective.

The entire equipment aside from the power plant probably weighs about 250 lbs. and hence is not extremely hard to transport.

Chairman Woodbridge: Mr. Woodbury has charge of that 150,000 volt line, that being the highest voltage in the world, I would like to hear from him on the deterioration of porcelain.

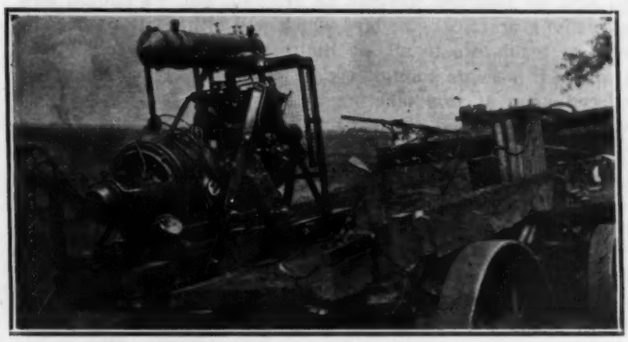
E. Woodbury: We have had one failure, but it is hardly chargeable to the porcelain. We had a large forest fire which damaged the insulators. There were 132 insulators on the tower, and immediately after the fire we took out about 50. After that there were some rains and it seemed that practically all the insulators on the tower were cracked internally. After this damp weather the balance of the insulators became defective. When the string of insulators broke down it seemed probable that all the insulators in the string



Attachment on Steel Tower for Testing Insulators

were defective. Outside of that there has been no case of insulator failure on the line. We megger the insulators every year and take out a per cent or two. At the present rate and from experience in the last four years it would seem possible to remove the defective insulators every year with the megger and get along without trouble.

Professor R. W. Sorensen: We took our clew from the high frequency coils made for medical men, and modified it to suit our conditions by building it in a small tub or keeler and immersing it in oil. This oscillator is a little fiber tub 20 inches in diameter. In it we have a coil of 3000 turns on one side and 32 turns on the other side, the 32 turn side being the primary. We bring a lead out to the top. We ground the primary side, that is, connect it to the secondary side. It is really in the form of an auto transformer, and we bring a lead to the top and put two spark gaps just far enough to arc over at a voltage just slightly over that which goes over the insulator, because this machine generates so much voltage that if we open the gap it will destroy itself immediately. Then we put a condenser in series with this machine and across the secondary of the transformer that steps up from 110 to 3500 volts. Also across the transformer we put a spark gap made of two pieces of silver. The arc surging across the gap produces our high frequency current which is somewhere from 200,000 to 250,000 cycles per sec-



Movable Power Plant for Testing Insulators

ond. We supply the energy for that on the road by a little power plant that we constructed by changing a 3 h.p. d.c. motor to a single phase alternator, driven by a motor cycle engine or from the engine of a Ford. When we want to test we have everything on the ground except the oscillator. Trailing back from the wagon you will see our ground wire which is a long piece of bare copper cable. The oscillator is drawn up the tower and some transformer cable carries current at 3800 volts from the transformer and other apparatus, up to the oscillator. The man having the outfit on the ground has a telegraph key to use for a switch. Two men press their sticks up against the insulator to be tested and numerous arcs are caused to travel over the insulator being tested.

Inductive Interference

Chairman Woodbridge: We will have a further opportunity for discussion of this matter when we see the oscillator and that will probably be a better time.

The next subject for discussion is Inductive Interference. The joint committee on Inductive Interference has contributed to the report of the engineering committee all that it is at liberty to say before it makes its final report to the railroad commission. I should like, however, to ask Mr. H. S. Warren, who has been representing the telephone interests, for his views on the situation. Mr. Warren comes to us from Mr. Carty's office in New York, and is particularly qualified to speak on this subject.

H. S. Warren: I am very glad to be here and to say a few words to you. The telephone companies are, of course, vitally interested in the matter of inductive interference as their service is directly affected. The subject is a very difficult one from a technical standpoint. About four years ago I had the pleasure of visiting this section of California and interviewing some of the representatives of the power companies, making the suggestion that an investigation be made of inductive interference and asking whether the power companies would be interested to co-operate in an investigation of that sort. The suggestion was accepted, every one that I saw agreeing that it was a subject which ought to be studied. A tentative plan which was relatively crude in form was looked over and favorably received. None of us had any idea at that time that the investigation would develop into what it has since become, having extended over four years of very hard and very excellent work. I don't know whether you gentlemen realize that this subject has been studied more thoroughly and the art has been advanced to a greater degree by this work in California in the last four years than has been the case in any other part of the world. There is no comparison, so far as I know, in the extent of work done and results reached. Still we have by no means exhausted the subject, it is so tremendously complicated and involved. I did not come here prepared to make a speech and I don't wish to go into the details of the subject. I think it is understood by all of you that the committee is now working on a final report which will include some revision of the existing rules. They will be improved as much as possible, and we hope in a comparatively short time that report will be available.

As to the special attitude of the telephone company on the subject, I will say that as far as I am personally concerned it is my ambition that this report shall be as nearly right as possible when we get it done. It is necessary in some cases to make what might be termed an arbitrary decision as to certain limits. The facts are so involved, the relations between them so uncertain, and sometimes necessary data is not available, that we have to estimate from all we can find out where the limits should be placed. It is my desire that these limits shall be placed at the proper points. We do not wish to make rules which are unduly burdensome. We are trying to get a treatment of this subject such that whoever at some future time does the work of revising the rules and looks back on the work of the present committee can say that it did a remarkably good job in its day and generation.

Chairman Woodbridge: Mr. Bridge has followed the work more closely than any other of the commission's engineers, and I would like to have the views of Mr. Bridge from the commission's point of view.

A. F. Bridge: The experience which the commission, the power and communication utilities have had in the application of general order No. 39, which as you probably know is the inductive interference order of the commission, based on the preliminary report of the joint committee, has indicated certain deficiencies and defects which as a result of its further work the committee hopes to remedy at this time. In fact, the first report was of such a preliminary nature, and the limitations recommended so general, that considerable criticism has been directed against the order on those grounds. I think, however, if it is borne in mind that it was necessarily a preliminary and tentative order, and if everybody could appreciate as I do the spirit of co-operation which has been engendered in the two opposing interests—communication and power companies—and consideration for the other man's difficulties, it would be realized that certainly no small work has been accomplished so far.

One of the chief objections to the original order was that no definition or limiting conditions were given which would indicate under what conditions a parallel was liable to be created. The committee has been doing considerable work in an effort to give information which will enable an engineer contemplating the construction of a power line in proximity to a communication line, to predict whether or not it will become involved in a parallel. There are so many factors affecting this matter, particularly with respect to para-

leis with telephone lines, that the results can be only approximate. However, we hope to furnish a guide for the predetermination of conditions which may cause inductive interference, and by adopting limitations based on the effect in reducing efficiency of telephone transmission or speed of telegraphic equipment to obtain a basis which will require, if these limitations are liable to be exceeded, the employment of certain mitigative measures in the construction of the line which will be far less expensive than if installed subsequently.

Another point which it seems necessary to cover is the question of prorating the cost of mitigation of interference or of avoidance of parallelism. This problem involves not only engineering and accounting but also the equitable responsibilities of each party.

While we feel that possibly we are not wholly qualified to cover all of these features, we have, nevertheless, evolved a rule for consideration of the lawyers and financial managers.

In the first order the question of parallels with grounded telephone systems was not covered, and we have found that it is desirable to do so since many such develop and must be cleared up. I think that is about the extent of what the committee hopes to accomplish. We expect to have this report completed in the immediate future, and I assume that will form a basis for a revised general order by the commission.

Standardization of Hardware

Chairman Woodbridge: I would like to have Professor Scrugham outline his request and his views on it, but he does not seem to be here at the present time.

The next subject on our program is the Standardization of the Hardware for Clevis Cap Suspension Insulators. A paper on this subject has been prepared by Mr. L. M. Klauber of San Diego. We will read the paper by title only and ask for comments and discussion.

Jos. S. Thompson: I would like to say that naturally all the manufacturers have standards of their own, not necessarily meshing in with the standards of other manufacturers. But even those standards have been disarranged recently by the fact that it has been very difficult for them to secure hardware to keep up with their demands, and every foundry has its peculiarities. Frequently insulators apparently complying with their outline drawings and standards, may have pinholes of the sizes that are prescribed, but the coring of the castings or the handling will make a difference in the clearances or location of the hole, and the eye and clevis will be crowded together. So it is at present difficult enough for the manufacturers to adhere to their own standards. It is to be hoped that they will all come to adhere to one that is fixed and to govern them all.

C. P. Leibold: I can only substantiate what Mr. Thompson has said. It is indeed one of the real troubles of the manufacturers nowadays, to get castings which look like his drawings.

We have to go to strange foundries. We are handling more material than we ever handled before, and it is four times as difficult to get the quantity as it was formerly. It is almost impossible to describe the troubles.

I have read Mr. Klauber's paper with a great deal of interest, and there is no question in my mind but that there is a certain field in which there is something to be done, especially for insulators for work on distribution lines. It might be that when made as Mr. Klauber describes, it might make them less efficient on suspension work, because it causes greater spacing between insulators and brings in a greater quantity of metal in the cap and in the stud casting. But that is something for investigation and that is something which does not enter nearly as much into the design of insulators for corner work on distribution lines. I know that the Ohio Brass Company and undoubtedly the other firms engaged in the manufacture of suspension insulators, will be glad indeed to seriously consider the standardization which your paper suggests.

A. Bowie: Insulators are often made with a change of diameter of the head of the top shell. This requires readjustment of castings to fit them, and has sometimes caused a good deal of inconvenience and trouble in the manufacture of switches. For instance, a quarter of an inch will make a difference between a cap fitting or not fitting on the insulator.

L. M. Klauber: Gentlemen, I want to make clear the present status of this proposition. At the time the engineering committee decided to investigate the matter of the standardization of the hardware of the clevis cap insulators, we had no knowledge that any action had been taken along these lines by the manufacturers or any operating company, but after corresponding with three of the manufacturers we learned, that just prior to the appointing of our own committee, representatives of the manufacturers had met in New York with representatives of the Electric Bond & Share Company for the consideration of the matter which we have before us. At this meeting, at which but one operating company was represented, they decided on a form of cap which is quite different from that which the majority of Coast companies have been using. The manufacturers have stated that while the clevis cap as adopted is in the future to be known as the Manufacturers' Standard, they are quite willing to give us modified designs as ordered, but we should now agree on a practical standard which will ultimately reduce the cost of insulators to all, by limiting the designs to at least two and if possible a single type. Unfortunately, the standard agreed upon at this meeting in New York is so largely at variance with what we have been using, being based on a ½ in. instead of a ⅝ in. bolt, that it is doubtful whether our Pacific Coast companies will ever adopt the new standard. Therefore, as this standard has not yet been discussed at engineering meetings, nor generally adopted by operating companies, it is not yet an official standard in any sense of the word, and if we desire to see it modified, now is the time to voice our opinions. In future it will become far more difficult to effect a change; so if any of you gentlemen, based on your experience, prefer the ⅝ in. bolt design given as a suggested standard in the report of this committee, which suggested standard closely approximates what he have used in the past, your protest should be made now.

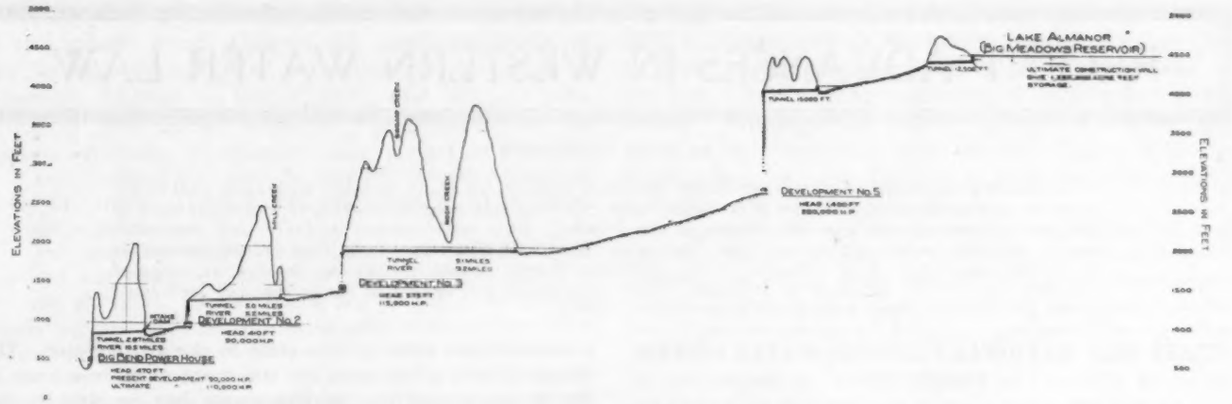
The manufacturers have given as the principal objection to the adoption of the ⅝ in. standard, the increase in the length of the string and the weight of the metal, but as a matter of fact any of these manufacturers will give us an insulator having a ⅝ in. bolt at the same price as the ½ in., and the increase in length will be found of minor importance.

Therefore this matter is brought before you for discussion in the hope that our operating engineers will express their opinions as to the relative merits of the so-called manufacturers' standard and the suggested standard.

J. P. Jollyman: If a standard is to be of any real use it should be a universal standard. The difference between the two standards, perhaps, is hardly sufficient to warrant the other people in holding out for their standard. I therefore move that the engineering committee take up with the proper committee of the national body of the N. E. L. A. the question of obtaining a universal standard which will meet all of our requirements and which will be carefully considered before being adopted.

(The said motion is seconded.)

C. O. Poole: Personally I can see that the ⅝ in. standard pin would serve all the purposes that the ½ inch pin would serve, and would certainly fit in with a great many insulators now in service. What little additional cost might be involved I don't think cuts much figure, and I am strongly in favor of adopting the ⅝ in. pin as standard. Another point is in connection with the metal on the lugs of the clevis. Three-eights of an inch is the standard we have been using and I think that is a very good plan. While the 5/16 in. might



Profile of Present and Proposed Developments on the North Fork of the Feather River, showing Location of High Head Turbines

be safe, yet I think the additional thickness of metal might insure better results.

S. J. Lisberger: I desire to call attention to one point. If this matter is to be referred to a committee of the National body, it should be borne in mind that the committee for 1917 has completed their work. The new committees do not commence work much before September. Would it not be well to bring your objections to the attention of the manufacturers, in order that they do not go too far on this work of standardization, asking that they await the result of the meeting of the National body before the apparatus is actually changed. In other words, the new committee, to which this is referred, very probably cannot arrive at a decision before next December and the manufacturers may have started these new standards before your report is brought to their attention.

(Thereupon motion as made and seconded is put and carried.)

High Head Francis Turbines

Chairman Woodbridge: The next subject for this morning's program is that brought out by Mr. Jollyman's paper on High Head Francis Turbines.

J. A. Koontz: There is just one point I wanted to bring out. In regard to high head turbine runners. The people on this coast feel that the Francis turbine runner must be subjected to rather serious wear, and that it is not to be classed with the Pelton runner. I wish to state since starting our plant on the Feather River in 1908, and at that time high head turbines were more or less in the experimental stage, we have operated with exceptional success under a 420 foot

Interior View of Las Plumas Power Plant on the Feather River

effective head. The wheels in question are 18,500 horsepower wheels. We have had runners of various materials in those wheels in operation almost continuously to the present time. We find that in the use of cast iron, bronze, cast steel or brass runners that there is practically no difference in the material used, the wear depending totally on the design. If your blades are properly shaped and the runner properly designed the wear is exceedingly small. About the only trouble we have had from wear is from clearance, and in the later units, this has been taken care of by putting on clearance bands which are removable. At the time of removing we have developed a special boring machine and the scroll-case is trued up and a new band put on the runner and the machine is brought back to approximately the efficiency it had when new. These runners have been in operation since 1908 and are still giving good service. We do not recommend cast iron runners, as we had a blade broken in one turbine by a large rock getting into the pipe line. At the present time we are standardizing on the cast steel runner, but only because we obtain it more cheaply. Sometimes the wheels operate practically two years without any attention and are never opened up in that length of time.

R. J. C. Wood: Might I ask the size?

J. A. Koontz: 18500 horsepower wheel, operating under 420 ft. effective head, at 400 r.p.m.

C. O. Poole: I wish to say we installed in 1907 a Francis turbine wheel in one of our plants, under a 400 ft. effective head. At the end of 6 months operating the efficiency dropped to about 60 per cent. We shut the unit down and put in new throat pieces and ran for another six months and it dropped to 40 per cent and we had to discontinue the use and put in a tangential wheel. The reason was due to the fact that we had cloudbursts during certain portions of the year which carried down a great deal of gravel which was responsible for the failure. We came to the conclusion that for our particular purposes we could not make use of the turbine wheel. I want to say also that we are operating under about a 60-foot head in our Imperial Valley district, some small turbines of about eight or nine hundred horsepower, using Colorado River water. The runners will last about two years, when they have to be entirely renewed, owing to the drop in efficiency from the scouring effect.

Chairman Woodbridge: What are the runners made of?

C. O. Poole: Bronze and steel. Bronze stands better, but at the present price of bronze we are not using very many bronze runners.

Chairman Woodbridge. Mr. Lighthipe, have you any turbine wheels on your system?

J. A. Lighthipe: We have none on our system, but we are figuring on two of the Francis type for the new development on the Kern River.

Chairman Woodbridge: President Ballard tells me that the commercial section is not through with its program. So we will run parallel sessions this afternoon and will start at 1:30. We will take up then the subject of joint pole construction.

(Thereupon an adjournment was taken until half past one.)

RECENT ADVANCES IN WESTERN WATER LAW

BY A. E. CHANDLER

(Comments suggested by recent legislation and court opinions on Western water rights are vital to the needs of engineers throughout the West who are in any way interested in hydroelectric development of the great natural resources of this section of the country. It is with unusual pleasure that announcement is herewith made to readers of the Journal of Electricity that one of our best known authorities on Western water law, A. E. Chandler of the California Water Commission, is to contribute a series of Comments on recent advances in Western Water Law which will appear in the columns of each issue of the Journal for many months to come—The Editor.)

STATE AND NATIONAL FEES FOR WATER POWER PROJECTS

In accordance with a recommendation of the State Water Commission, the 1917 California legislature, by an act effective July 27, 1917, so amended section 23 of the water commission act that the fees in connection with new power development are materially lessened. Before amendment section 23 provided for an application fee of $2.50 per theoretical horsepower up to 100 horsepower, of $500 from 100 to 10,000 horsepower, and of $1000 above 10,000 horsepower. It also provided for an annual charge, after the issue of license, of 25 cents for each theoretical horsepower. The section as amended provides for a filing fee of $5 and, upon the issue of a permit the additional fee of 10 cents per theoretical horsepower up to 100 horsepower, of 5 cents per horsepower from 100 horsepower to 1000 horsepower, and of one cent per horsepower above 1000 horsepower. The annual charge has been eliminated. The application and permit fees are similar to those in force in Nevada and Oregon and exactly the same as those provided for in the "new water code" adopted by the 1917 legislature of the state of Washington.

The California water commission made the above recommendation regarding change in filing fees as applications for power purposes were discriminated against under the existing system. Applicants for purposes other than power had to pay a filing fee of $10 only—regardless of the size of the proposed project. Irrigation, municipal and similar applications mean a proposed complete depletion (excepting "return waters") of available water supply by the amount to be delivered. Power applications on the contrary contemplate a return of the diverted water for further use below. Section 23 as amended places the filing fees for irrigation and power purposes on somewhat the same basis.

The annual charge has been eliminated under licenses for the diversion of water for any purpose as no sound argument could be found for its retention. It was probably originally based on the idea that the state owned the water and therefore should secure a return on its use. In approving a permit or issuing a license, however, the state gives no guarantee of the water right and the holder thereof must protect himself if litigation be initiated by riparian owners or prior appropriators. The supreme court of California in Palmer v. Railroad Commission (167 Cal. 163, 167) expressed itself as follows on this point:

"The theory that the water of a non-navigable stream in this state is in some sense 'public water' has been advanced before. It has been claimed that a diversion of water under the provisions of the Civil Code (secs. 1410 to 1422) constitutes a grant of the water by the state to the appropriator. The idea may have arisen from the statement sometimes made in the decisions that the riparian owner has no right in the corpus of the water (Eddy v. Simpson, 3 Cal. 252, [58 Am. Dec. 408]) and that running water cannot be made the subject of private ownership, that the right to use the water of a stream 'carries no specific property in the water itself.' (Kidd v. Laird, 15 Cal. 179, [76 Am. Dec. 472]) This is far from saying that the property in the water is vested in the public, either for general use, or as property of the state. The doctrine that it is public water, or that it belongs to the state because it is not capable of private ownership, has no support in the statutes of the state or in any decision of this court."

In a petition for rehearing the attention of the court was directed to the 1911 amendment of Section 1410 of the Civil Code, adding the words: "All water or the use of water within the state of California is the property of the people of the state of California." The court's interpretation follows:

"The amendment may possibly be effective as a dedication to general public use of any riparian rights which the state at the time it was enacted, may still have retained by virtue of its ownership of lands bordering on a stream, rights in the stream which it would in such cases have in common with owners of other abutting land. It could not affect the riparian rights of the other owners, nor the rights of any person or corporation claiming under them, nor rights previously acquired from riparian owners by prescription, nor rights acquired from the state prior to that time by appropriation under the code, in reliance upon the implied offer of the state to allow its riparian rights to be acquired in that manner, as indicated in the opinion."

No western state, other than California and Oregon, has attempted to levy an annual charge for the appropriation of water. The Oregon statute (1911) applies to all water power plants and not only to new ones as first provided in 1909. The attitude of the supreme court of the strictly arid states (where the doctrine of riparian rights to the use of water is not recognized) towards constitutional and statutory provisions declaring that the waters of streams, etc., are the property of the state or belong to the public, is well typified by the following from the Idaho case of Walbridge v. Robinson (125 Pacific 812, 814):

"We think it is clear that the title to the public waters of the state is vested in the state for the use and benefit of all the citizens of the state under such rules and regulations as may be prescribed from time to time by the law-making power of the state. This is not, however, an interest or title in the proprietary sense, but rather in the sovereign capacity as representative of all the people for the purpose of guaranteeing that the common rights of all shall be equally protected and that no one shall be denied his proper use and benefit of this common necessity."

The contention is often made that the waters of western streams belong to the nation and not to the

state, and it was particularly pressed in a recent case in the federal court wherein the constitutionality of the Nevada "water code" was attacked—Bergman v. Kearney, decided in March, 1917, and not yet published in the Federal Reporter. In disposing of the contention Judge Farrington said in part as follows:

"Any extended discussion of plaintiffs' second contention would be largely academic, and could lead to no profitable or decisive conclusion. * * *

"For years the national government has consistently recognized and respected rights acquired by appropriation to the use of water. It has conformed to the state statutes regulating the acquisition of unappropriated water; and when its proprietary interest in the use of running water has come in conflict with that of the individual, it has, like the individual, resorted to the courts for settlement and adjustment."

The fees fixed by the regulations of the Forest Service are however not based on the claim of federal ownership of the water but of the land. That the applications to the Forest Service are for right of way privileges and not water rights is emphasized in the following from Utah Power & Light Co. v. United States (37 Sup. Crt. Rep. 387, 392) decided by the United States Supreme Court March 19, 1917:

"Much is said in the briefs about several congressional enactments providing or recognizing that rights to the use of water in streams running through the public lands and forest reservations may be acquired in accordance with local laws, but these enactments do not require particular mention, for this is not a controversy over water rights, but over rights of way through lands of the United States, which is a different matter, and is so treated in the right of way acts before mentioned. See Snyder v. Colorado Gold Dredging Company, 104 C. C. A. 136, 181 Fed. 62, 69.

"As the defendants have been occupying and using reserved lands of the United States without its permission and contrary to its laws, we think it is entitled to have appropriate compensation therefor included in the decree. The compensation should be measured by the reasonable value of the occupancy and use, considering its extent and duration, and not by the scale of charges named in the regulations, as prayed in the bill."

In a pamphlet entitled "Water Power" (prepared in connection with the Ferris Bill) Secretary Lane said in part:

"The true value of power sites is, then, not the nominal figure of $1.25 per acre, not their value as agricultural lands, timber lands, or coal lands, but their value as dam sites, reservoir site, or for other uses in connection with water-power development, and for this purpose the larger and more valuable sites are worth millions of dollars."

Secretary Lane specifically argued against the government asking a return on any such amount, but the above statement represents his view of values. The subject is decidedly a debatable one among both engineers and lawyers. The Interior Department, through its Reclamation Service, is probably the greatest single user of reservoirs. Its engineers in negotiating for its many reservoir sites strenuously objected to allowing anything in excess of a good market price for the tracts as agricultural land or timber land. To revert to the expression used in the above quotation from the Utah Power Company case, the experienced engineers of the Reclamation Service could not endorse the secretary's value of "millions of dollars" as a "reasonable value of the occupancy and use."

United States v. Colorado Power Co. (240 Federal 217) is a case wherein the power company refused to pay the annual charges fixed by the Department of the Interior and of Agriculture and its permit was revoked. Although the District Judge who wrote the opinion reflected somewhat on the character of the regulations, he held that the charges must be paid—as is shown by the following:

"And while the Act clearly does not contemplate full compensation for the privilege to be enjoyed, otherwise it would have said so, still it seems reasonable that the power should include the right to exact a sum needful for the proper protection of the complainant's interests. Congress did not manifest any intent to give the secretary the right and power to acquire for complainant an interest, directly or indirectly, in defendant's plant or business, nor to lay a tax on its product; and to put the defendant's business under public surveillance and thus subject it to examination as to the amount of electrical energy produced and disposed of, for the purpose of laying tribute thereon as a basis of a charge to be fixed by the secretary, is to carry the power granted to him to a doubtful length and further than, I think, is given by the Act. The charge made, and to which the defendant objected and refused to pay, was ascertained in that way. There is no present duty or purpose in these expressions to finally determine and adjudicate the limit of power in this regard, further than to say that the statute left a doubtful field of action for both sides, and the course taken by the defendant ought not to be construed as a risk of all it had. The average amount thus fixed was approximately $100 per month. There is no proof that this is unreasonable and excessive and more than necessary in the protection of the complainant's rights; and the manner in which it was fixed is not of present concern, except that it operated as the chief cause for the resistance to the demand. It is enough now to say that I cannot find on the proof that the amount demanded was excessive or unreasonable."

The decisions clearly hold that the charges must be reasonable—and reasonable as based upon the value of the property occupied and not upon the value of the company's business. As the owner of lands the government has the undoubted right to charge for their use. The elimination of the charge must rest upon public policy and not upon law. Public policy, however, dictates consistency. If the government will exact from every industry using its lands in the future a charge commensurate with their value, the miner, the railroad man and the irrigator may object, but the polisy thus inaugurated would at least be consistent. Water power development when but an infant was thought to wave a golden spoon, which now in the clearing light of experience is slowly being recognized as the workman's most indispensable tool. It is high time, therefore, for discrimination to cease.

MORE WATERPOWER UTILIZED IN SWEDEN

Owing to the scarcity of coal and coke, hydroelectric power plants are being extended and new ones constructed with all possible speed. The government hydroelectric power plant at Trollhattan is being enlarged by eight new machine units. The flow from Lake Vanern will be regulated at an expense of 13,000,000 crowns ($3,484,000), and a new power plant near Trollhattan is to be built.

The government water power board has drawn up a preliminary contract for the delivery of 12,000 kilowatts of electric energy from the power station at Trollhattan to the Aktiebolaget Elektro-Saltpeter.

SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A SCHNEIDER

(Proper advertising and proper ideals of service are commercial factors that enter largely in the final balance sheet of success or failure with the contractor and dealer. In this column will be found excellent discussions on these two subjects. Protective devices for storage battery charging circuits also come in for their share of discussion at this time when information of this nature is most helpful. The author is power apparatus specialist for a large electrical supply house in the West with headquarters at San Francisco.—The Editor.)

SPIDERS VERSUS ADVERTISING

Mark Twain, who was a firm believer in good advertising, is said to have told the following incident at a famous dinner:

"When I was editing 'The Virginia City Enterprise,' writing copy one day and mining the next, I tried in many ways to drive home the fact that advertising pays. One day I received a letter from a subscriber saying that he had found a spider pressed between the pages of his paper. He wanted to know whether this signified good or bad luck. I replied, 'The finding of a spider in your copy of The Enterprise was neither good nor bad luck. The spider was merely looking over our pages to find out what merchant was not advertising in them, so that he could spin his web across his door and lead a free and undisturbed existence forever after.'"

BUSINESS VEXATIONS AND SOME OTHER THINGS

You should not expect to sell to those who do not know you or your store. Advertising is the most effective way of telling possible customers what you have to sell.

It is the easiest thing in the world to sell goods—if you have the right goods—but you must know how to tell the people about them entertainingly.

A dealer who expects business to come to him without effort on his part lacks knowledge of human nature. If he wants business he must go out and get it.

Some men do things in a certain manner because their fathers did so before them and were successful. They cannot realize that the wonderful of today becomes the ridiculous of tomorrow.

To know a "good thing" is to be only half wise. To know it and use it to advantage is true wisdom—in business.

Now, Mr. Dealer, suppose the big brother of this spider should follow out a similar scheme in trying to locate a permanent home. Would he find your ad in the columns of the local paper? Or suppose in his travels the spider stopped for a rest in your show window and while doing so looked it over and decided to stay. Would he be safe in spinning his web there and not be disturbed for weeks to come? More directly, the question is, "What are you doing to advertise your business—to create a demand for more electrical goods or your services—or to let the public know that you can supply the nationally advertised electrical goods and appliances?

Just now the big men who are closely in touch with out country's needs are telling us to "keep business going." One way to do this is to advertise. The old axiom "It pays to advertise" is more applicable today than ever before and right now each of us in the electrical industry should give this simple truth charge by manufacturers and jobbers.

If you talk advertising to some dealers right away you will find them thinking of more expense. But advertising is not an expense if properly handled and should not be so considered. It is an investment—and fortunately for the dealer—a very small one if he will take advantage of the sales helps, such as lantern slides, envelope stuffers, display racks, window displays and the like which are furnished to him free of more serious thought than ever before.

If you are not making use of these helps begin today. Get in touch with your jobber and see what he has to offer in this line. Select those helps you think best meet your needs. Then put them to work at once. You will be surprised with the results. Persistent, systematic, personal solicitation backed up with a neat, clean, well-arranged show window and the right amount of printer's ink makes for better business. Try it!

OPERATION OF D. C. GENERATORS

Satisfactory results should not be expected from a direct current generator unless it is operated under practically normal conditions. Any deviation from these conditions may seriously effect the temperature rise or the performance at the commutator. Normal conditions are fulfilled when a machine is operated at its rated speed, potential and current output and in a room in which the temperature is not abnormally high. Failure to observe these points is the direct cause of much trouble. This statement is especially applicable to generators used for battery charging in garages. In such service generators are likely to be operated under abnormal conditions because of the varying number of cells to be charged and the widely different charging rates.

The two essential points to be remembered are that there is a limit to both the maximum and minimum voltage at which a given generator can be successfully operated and that the rated current output should not be exceeded beyond the regular overload value under any condition. Analyzed further these limitations bring out the fact that we should not demand of a machine its rated energy expecting to obtain greater current output if operated at reduced potential or vice versa. Yet this is just what many garage men and others try to do. They understand that the product of the volts times the amperes in a direct current circuit equals the watts. Therefore they figure if one is reduced the other can be increased in

proportion just so the product of the two values does not exceed the watt capacity of the machine.

The most economical method of reducing the voltage is by regulating the field strength of the generator by means of a field rheostat. There is, however, a certain value below which the voltage cannot be lowered without producing excessive sparking. The range will depend entirely upon the design. In one line of motor generator sets the voltage can be varied from 60 to 120 per cent of normal. In another line of special battery charging generators the voltage can be reduced to about 20 per cent of normal by field control, but at the lower value the rated current output cannot be exceeded so the output is reduced as the voltage is reduced. When the minimum voltage is not low enough the difference must be taken up by an additional rheostat in series with the load.

Likewise there will be excessive sparking and heating if the voltage is raised above a certain value. Sometimes this is done by increasing the speed of the generator in an endeavor to charge a larger number of cells.

These points are nicely illustrated by a case of trouble that came to the writer's attention some time ago. A motor generator set had been made up outside the factory by connecting a 1000 r.p.m., 110 volt shunt motor to a 50 cycle three-phase motor with a load speed of about 1450 r.p.m. This set was intended for charging an electric vehicle requiring about 70 volts at full charge. When the voltage was reduced to this value by the field rheostat there was excessive sparking and the charging current uctuated over a wide range. It was found advisable to order a new generator of the proper speed and voltage. The difficulty was caused by the very weak field which was not sufficient to give good commutation due to the cumulative effect of a greatly increased speed and reduced voltage.

Observation of these points will eliminate many troubles and incidentally much needless expense.

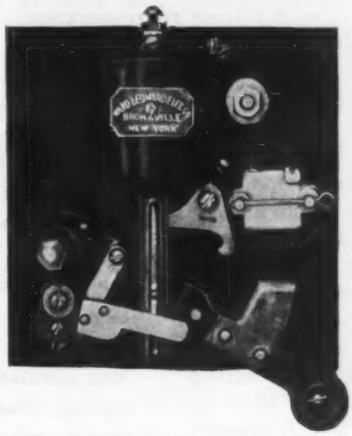
PROTECTIVE DEVICES FOR STORAGE BATTERY CHARGING CIRCUITS

In connection with storage battery charging equipments some form of protective device is necessary to prevent the discharge of the batteries when the charging circuit fails. The kind of device best suited for any particular installation will depend entirely upon the method of charging, the source of the charging current and whether the batteries are charged from a constant or varying voltage circuit.

Some batteries are charged from direct current constant voltage systems that are used also for light or power purposes. Others are charged from motor generator sets supplying a large number of battery circuits. These generators are usually operated at a fixed voltage and the charging current to the different circuits is regulated by a separate series rheostat in each battery circuit.

Again batteries are often charged from a motor generator set having a generator designed to work over a considerable range of voltage which enables the charging current to be regulated by the field rheostat thus eliminating the wasteful series rheostat. Batteries for farm lighting plants are charged from constant voltage generators usually driven by gasoline engines. In this case there is likelihood of the engine stopping or slowing down which would allow the batteries to discharge if a suitable protective device were not provided In such installations it is desirable to have a device that will automatically cut in the battery when the engine comes up to speed and thus restores the generator voltage to normal. Thus it will be seen there are a number of different conditions to be met even in connection with the simple circuits or equipments.

The simplest form of protective device for battery charging circuits is the plain underload type of circuit breaker illustrated in the accompanying figure. This breaker has a single operating coil which is placed in series with the battery. It is so designed that a cer-



New Protective Device for Charging Storage Batteries

tain amount of current must pass through the coil to hold the breaker closed. If the current falls below a certain value the breaker will open and remain so until manually closed. The breaker would therefore open in case the charging circuit should fail. However it would not prevent the battery from being charged in the wrong direction in case the polarity of the charging circuit should become reversed. This is a disadvantage for certain classes of work. By adding another series trip coil these breakers can be arranged for combined overload and underload operation. In ordering this type of breaker it is necessary to specify the ampere capacity required. Also to check the minimum current required to hold the breaker closed. This will range from about 6 to 20 per cent of the normal carrying capacity of the holding coil.

In a later issue another type of breaker and the automatic forms of cut-out switches for this service will be described.

Data on the effect of resin on the durability of woods have been worked up for over a hundred samples of longleaf pine. The results, when considered as averages for four durability clases, indicate that increasing amounts of resin tend to be directly correlated with increased durability. Individual blocks do not necessarily bear out this relation, showing that there are other factors involved.

FUEL OIL AND STEAM ENGINEERING

(A simple relationship of temperature and pressure for the boiling point of water is of high practical importance in steam engineering and fuel oil practice. Other mathematical relations such as total heat of steam, specific volume of superheated steam enter also into computations at certain times in preference to data that might otherwise be taken directly from the steam tables. These equations are discussed in the following article and the reader is shown how they may be applied and to what degree of accuracy they may be depended upon.—The Editor.)

RATIONAL AND EMPIRICAL FORMULAS FOR STEAM CONSTANTS IN FUEL OIL PRACTICE

BY ROBERT SIBLEY AND CHAS. H. DELANY

It has hitherto been pointed out that the relationships of temperature, latent heat and other steam properties are so complicated with varying pressures that no one as yet has been able to set forth simple mathematical equations for their representation.

There exist, however, a vast number of more or less complicated formulas that express with some degree of accuracy a relationship between these various factors. When such a relationship is deduced from some process of reasoning based upon known laws the equation is said to be rational. If, on the other hand, some one by sifting through the sands of time, as it were, has happened upon an equation with no rational backing the formula is said to be empirical.

Most of the equations used to set forth steam variables are partly rational and partly empirical.

Any equation, unless it be comparatively simple, is of little practical use to the steam engineer for he may pick the values desired from the modern steam tables with such facility that it is really burdensome to try and remember any formulas connecting these properties.

The Value of Formulas in Steam Engineering.—In certain theoretical reasoning, however, a formula setting forth these relationships becomes often of inestimable value and indeed at times leads one to attain data otherwise impossible to compute. Such is the case of the formula from which the specific volume of saturated steam is obtained by computation and set forth in the last chapter. Here it is found impossible to obtain by experiment that which is easily computed by application of this formula.

We shall next set forth some of the comparatively simpler relationships or equations that have been devised or annunciated by various authors. These will serve to give the student an insight only into such complicated formulas that arise in attempting a mathematical expression for these data.

Unless one desires to go deep into the theoretical discussions of vapors and superheated gases such a brief introduction is nevertheless fully sufficient for the mastering of most problems in steam engineering computation.

Relation Between Temperature and Pressure of Saturated Steam.—It has already been set forth that water boils or that saturated steam begins to be formed from water at different temperature of each variation in pressure. No one as yet has set forth a simple rational formula connecting this relationship. In the issue of Power of March 18, 1910, is to be found a formula which is the simplest and yet one of the most accurate empirical relations yet established. This formula connects the temperature in Fahrenheit degrees with the pressure in pounds per sq. in. at which water boils and is as follows:

$$t = 200p^{\frac{1}{4}} - 101 \quad \ldots\ldots (1)$$

For a pressure of 10 lb. per sq. in. the error is but 0.28 per cent while for 300 lb. per sq. in., it becomes but 0.32 per cent. The intermediate values are far less in error, so that this formula has, indeed, a wide range of usefulness.

The Total Heat of Saturated Steam.—Almost a century ago Regnault gave to the world his celebrated data on steam engineering. So accurately and so carefully did he perform his work that even today his experimental results are used in steam engineering computation, although of course corrections are applied where certain constants involved in computation are now known to have different values.

Regnault's Formula.—Regnault's formula for the total heat H_t of saturated steam at temperature t is one of the simplest ever invented and is as follows:

$$H_t = 1091.7 + 0.305\ (t - 32) \quad \ldots\ldots\ldots\ldots (2)$$

THE CALL FOR MARINE ENGINEERS

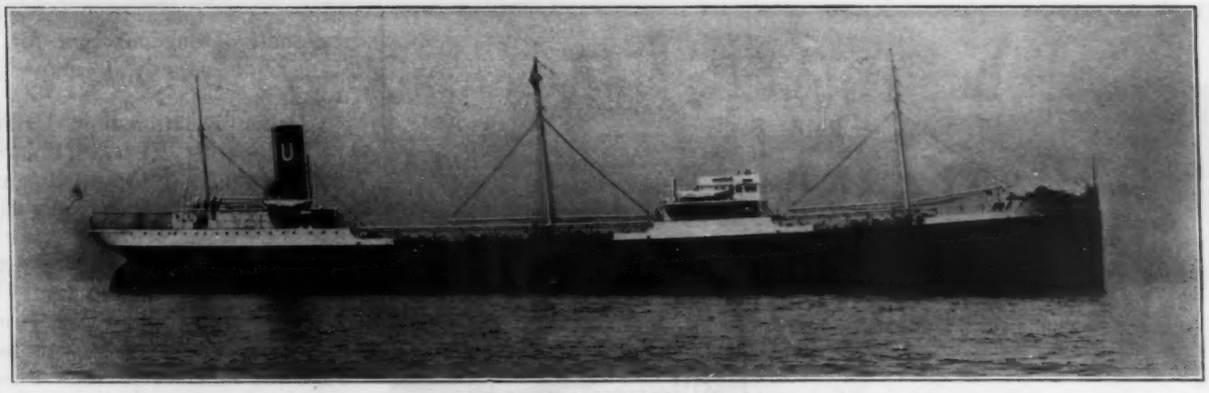
The Journal of Electricity has prepared to meet the newest and latest call upon the engineering talent of the West. Hereafter this department will not only serve to disseminate educative knowledge on fuel oil and steam engineering for central stations but its kindred applications on board ship will also be discussed.

The merchant marine will need within 18 months 5000 additional engineers in all grades. To start in training those not yet qualified to secure United States inspection papers, the government will open on July 2 a chain of free schools in marine engineering at some of the best known technical colleges in the country, for which marine engineers of all grades, oilers and water tenders, also stationary engineers are eligible; duration of term, one month.

After passing examinations of steamboat inspection service, students will have opportunity for further training under service conditions until wanted on ships at the new merchant marine.

The designated free engineering school for the West is Washington University, Seattle. Candidates for admission should apply to President Henry Suzzalo in charge of the course.

The data set forth in this department of the Journal should be found extremely useful for preparation in this latest call for national service.



S. S. LA BREA IN BALLAST TRIM

This is the first oil tank steamer equipped with reduction gear turbines. A product of a Western port, its features are representative of typical fuel oil and steam engineering practice that will be encountered in future service on the Pacific Coast.

Let us test this formula by comparing its results with those set forth in the steam tables for 235° F.

Regnault's Formula:

$$H_{235} = 1091.7 + 0.305\ (235 - 32) = 1153.6 \text{ B.t.u.}$$

$H_{235} = 1158.7$ B.t.u.

$$\therefore \text{Error} = \frac{1158.7 - 1153.6}{1158.7} \times 100 = 0.44\%$$

Hence we see that for low temperatures the error involved by using the classic equation of Regnault is less than one-half of one per cent.

Henning's Formula.—Marks and Davis have in the rear of their steam tables set forth a formula of Henning, which though somewhat more complicated than Regnault's is, however, very accurate. This formula may be expressed as follows:

$$H_t = 1150.3 + 0.3745\ (t - 212) - 0.000550\ (t - 212)^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Let us now test the accuracy of this formula by substituting the same temperature of 235° F. as used in Regnault's formula.

By Henning's formula:

$$H_{235} = 1150.3 + 0.3745\ (235 - 212) - 0.000550\ (235 - 212)^2 = 1158.64 \text{ B.t.u.}$$

From steam tables:

$H_{235} = 1158.7$.

$$\therefore \text{Error} = \frac{1158.7 - 1158.64}{1158.7} \times 100 = .0052\%$$

Hence the error involved in the use of this formula is seen to be extremely slight.

Latent Heat of Evaporation.—Thiesen, after observing certain limits toward which the latent heat of evaporation seemed to tend, suggested the following formula for the latent heat of evaporation of water:

$$L_t = 138.81\ (689 - t)^{0.315} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Let us compare this with the steam table data for a temperature of 235° F.

Thiesen's formula:

$$L_{235} = 138.81(689 - 235)^{0.315} = 953.7.$$

Steam tables:

$L_{235} = 955.4$

$$\therefore \text{Error} = \frac{955.4 - 953.7}{955.4} \times 100 = 0.178\%$$

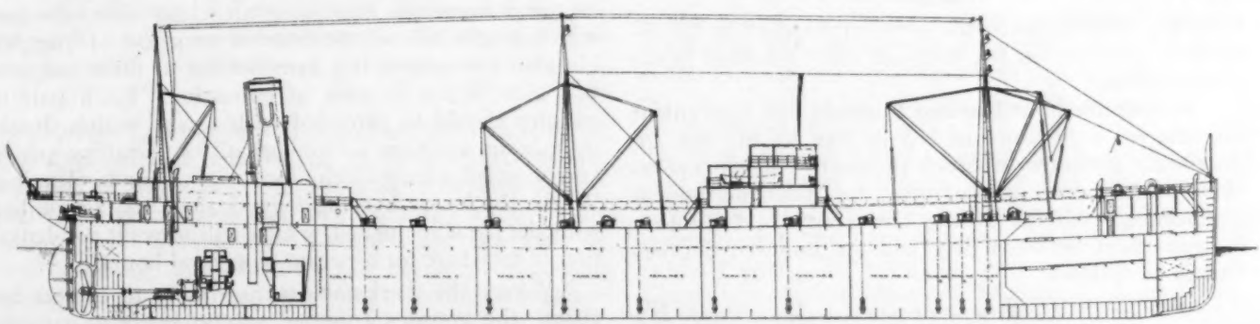
While the error here found is comparatively small, at higher temperatures this error becomes excessive. Hence we should apply this formula with due regard to its limitations.

A Second Formula for Heat Evaporation.—Students in the classes of mechanical engineering at the University of California have established a relationship for latent heat and temperature as follows:

$$L^2 = 1209423 - 1289.5\ t \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

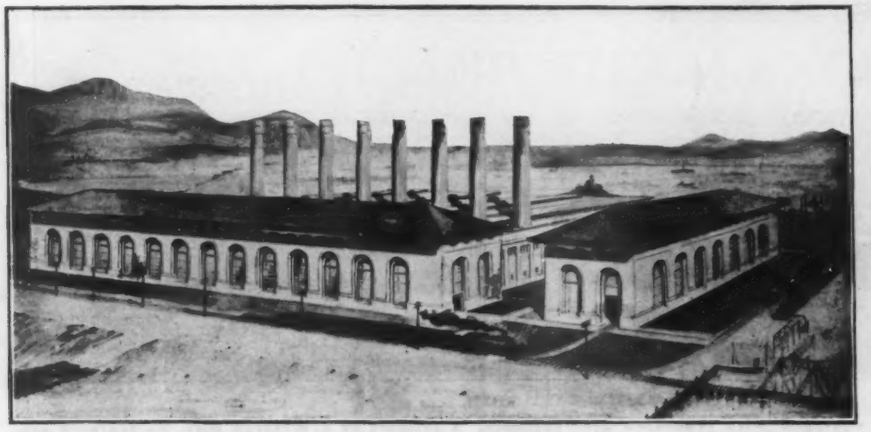
This formula is simple and yet accurate to within one-third of one per cent for a wide range of temperatures of from 100° F. to 350° F. and with three-fourths of one per cent for practically the entire range involved in steam engineering practice. The constants set forth were obtained by the method of Least Squares.

Relationship of Specific Volume for Superheated Steam.—In the chapter on Heat and Elementary Laws



THE PROFILE OF THE S. S. LA BREA

Herein is shown the general arrangement for cargo and for engine operation. Unique features of its equipment are the independent submerged cargo pumps, operated by electric motors on the deck.



THE LONG BEACH PLANT OF THE SOUTHERN CALIFORNIA EDISON COMPANY
In general the fundamental operating equipment of the modern central station plant, oil fired, is quite similar to the fuel oil and steam installation features aboard the modern high powered steamship. Consequently the thorough grounding in the one enables the engineer to quickly adjust himself to the new conditions met with in the other.

of Thermodynamics, it was shown that the pressure, volume, and absolute temperature of a perfect gas are connected by a very simple relationship as set forth in the composite formula given in equation (5). Indeed, it was shown that while superheated steam is not a perfect gas, still for approximate results this equation may be used.

For accurate work, however, the equation of Linde is found quite satisfactory although exceedingly cumbersome in its application. This equation connects the pressure p in pounds per sq. in. and specific volume v in cu. ft. per pound with the absolute temperature T in the following relationship:

$$pv = 0.5962\ T - p\ (1 + 0.0014\ p)\ [\frac{150300000}{T^3} - 0.0833\ ] \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

To illustrate the application of this formula, let us endeavor to find the specific volume of superheated steam at 526.8° F. used in a turbine test when the steam was under a pressure of 187.2 lb. per sq. in. absolute.

It is seen that the absolute temperature of the superheated steam was

$$T = 526.8 + 459.6 = 986.4$$

and since the absolute pressure p was 187.2 lb. per sq. in., we have

$$v = 3.05$$

From steam tables:

$$v = 3.05$$

Hence in this instance the formula appears to be absolutely accurate for the range of units involved in the steam tables.

A Simplified but Limited Formula.—A convenient formula for a pressure of 175 lb. per sq. in., the approximate pressure involved in steam turbine operations, has been worked out by the mechanical engineering students at the University of California for superheat between fifty and six hundred degrees and is as follows:

$$v = 2.67 + .00377\ t_s \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Wherein t_s is the number of degrees superheat. The accuracy of this formula is within one-half of one per cent for the range of superheat above set forth.

Other Relationships Exist.—By making use of certain theoretic considerations in thermodynamics many other equations might be written setting forth still other relationships involved in the determination of steam constants, but sufficient illustrations have now been given the reader for a thorough introduction to such formulas. Perhaps after all the most important lesson one derives from their use is that their application is often so tedious and their range of accuracy often so questionable, that one had better stay on well trodden paths and master to their fullest extent the application of the steam tables and diagrams in the solution of all steam engineering problems.

(Continued from page 13)

come, if he uses judgment in securing the proper type for the particular occupation, and if he is careful to see that the goggles are fitted as nearly as possible to the size of face and nose of the workman. Some goggles are made with several different sizes of nose bridges, while in other makes the correct adjustment may be obtained by simple bending.

It is often necessary to first convert the foreman to the need of eye protection. The men should be asked to give the goggles a trial for a few days, after explaining the need for wearing them. They should be told that the eye is the most useful organ of the human body which is exposed and in direct contact with "all outdoors." It should be forcefully presented to them that of all five senses—hearing, feeling, tasting, smelling and seeing—the last is the most important, for with the loss of vision comes utter dependence on others for a livelihood. Bulletin boards should be provided and pictures posted, showing how eyes have been saved by using goggles, and how eyes have been lost, with all the entailing misery, where the eyes were not protected.

Individual goggles should be provided by the employer without cost to the wearer. When the employe has his own goggles, which are for his use alone, he need have no fear of contracting skin diseases which might follow the promiscuous use of goggles. He also becomes better accustomed to their use, and this aids in the process of education. Each pair of goggles should be provided with a case, which should contain in addition a "nonsweat" or paraffine pencil and a small clean cloth for wiping and cleaning. Where the lenses become fogged, they may be rubbed with the paraffine pencil, which will prevent condensation of moisture for a period of several hours.

Where the workman wears glasses to correct his vision, the goggles supplied should be large enough to permit wearing of the regular glasses.

SPARKS—Current Facts, Figures and Fancy

(Investigations in accountancy, electric water heating, electric vehicles, corporation efficiency and a host of other useful things, have been conducted by the National Electric Light Association during the past year. Briefs of many of the useful conclusions that have been drawn appear in the following notes. Other data of helpful turn may also be found below which perchance may offer a suggestion for further inspiration in your work.—The Editor.)

The United States Geological Survey estimates that the known supply of metals of the platinum group in the world is possibly five million ounces.

* * *

Pulverized fuel from lignite is being investigated as a possible fuel for locomotives in the West in order to economize and conserve the fuel oil supply.

* * *

The National Electric Light Association in its Rate Book for 1917 gives a tabulation of the rates in force in cities of 40,000 population and upwards. All general rates, field or published are included in the book.

* * *

The efficiency of recently designed steam-turbine-driven centrifugal pumps has risen steadily with the experience of the builders and with improvements in auxiliary equipment, until duties under standard steam conditions exceeding 150,000,000 ft. lb. per 1000 lb. of steam are now obtained.

* * *

Temperature tests on seventy-two different species of wood-destroying fungi have been made at 24 deg. and 40 deg. C. The lower temperature has proved to be the best temperature for twenty-two species, while at the higher temperature fifty-four of the forms have shown no growth in three weeks.

* * *

The smelter production of primary copper in the United States during the past year was almost two billion pounds, netting an increase of nearly forty per cent over the previous year. Surely the electrification of railways will not be wanting for copper when the proper time arrives for its installation.

* * *

The recent publication entitled "California, its Resources and Possibilities," by the California Development Board, at San Francisco is a splendid compendium of useful information to all interested in securing helpful items for putting the best foot forward in presenting possibilities of the west.

* * *

Future development of power in America is being urged in such a manner as to stop indiscriminate building of small power houses and to develop a complete and continuous network of wires all over the country, not necessarily all owned and operated by one company, but probably the better arrangement would be to have individual distributing companies in each community.

According to the report of the electric range committee of the National Electric Light Association from investigation it appears that electric cooking has been practiced economically and successfully for many years where rates and conditions have been favorable. It is increasing by leaps and bounds, gaining in popularity much faster than is generally realized, and the future holds infinite possibilities.

* * *

The accountant section of the National Electric Light Association has recommended that the association employ a high-grade man, well versed in central station accounting, whose mission is to be—upon request—to visit the small central stations, and in co-operation with their accounting departments, assist in initiating standardized systems suited to their requirements, and otherwise render help of a practical and valuable nature.

* * *

A standardized system of accounting has been recommended to the member companies of the National Electric Light Association, thereby making a form readily available for comparison and for efficiency study. One result is predicted to immediately follow, namely, that when the costs of electric vehicles are intelligently contrasted with those of gasoline and horse-drawn conveyances, the merits of the electric vehicle will be quickly apparent.

* * *

The National Park in Alaska which Congress created last spring is one of the monster spectacles of the world. To say that Mt. McKinley rises 20,300 ft. above sea level and that it is the loftiest peak in America is to convey no idea whatever of its grandeur. North of the vast mountain is a rolling country dotted with beautiful lakes and forests and inhabited by enormous herds of caribou, with untold possibilities of future water power development.

* * *

With favorable weather from now on the total winter wheat yield may somewhat, though not materially, exceed the harvest of last year. At this stage of the growth of the spring wheat crop all that can be reasonably said is that the law of chance is for a greater production than last season. If, however, we should not have as much wheat to export as would be necessary, there seems a strong probability that we shall have other available food supplies, such as corn, oats, potatoes, and the like—not only in full measure but running over. Such are the assurances given by the Committee on Statistics and Standards of the Chamber of Commerce of the United States.

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THE RED CROSS

When amidst the roar of cannon, the din of musketry and the carnage of battle the American soldier sinks to the dust, raising himself to take one long, last look of life, he hears in memory's faint echo that plaintive strain, "Home, Sweet Home," may that faint echo convey with it the inward realization that the nation as a family have joined with him in giving of the same love, of the same human affection and of the same sacrifice of all. Such are the sublime aspirations and ideals of that one great piece of human machinery—the American Red Cross.

More Effective Governmental NurturingNeeded

One of our Eastern contemporaries in writing editorially on the agricultural needs of the Far West states that there is no dearth of oil in California. It is rather surprising that a statement such as this should be made by one so high in authority, when the official reports of the state mineralogist and a recent address of Van H. Manning, director of the U. S. Bureau of Mines are generally available, which show conclusively the rather precarious state in which fuel oil now finds itself. Those of us immediately on the ground, however, realize full well the seriousness of the situation and that it is not competition with gasoline and oil engines that is to be feared, but rather is it to be hoped that enlarged and nurtured development of the gigantic water powers of the West may at the earliest date possible be properly made under more encouraging conditions from governmental authorities.

The Irresistible Trend toward Centralization

The recent effective consolidation of the two great hydroelectric organizations of Southern California, combined with efforts that are being made to conserve the fuel oil and safeguard the service of central station activities throughout the West, lead thoughtful men to ponder the question "Why not state-wide consolidation of all utility effort of this nature?"

Surely the policy of the regulatory bodies is not against such action, for long since decisions have been put on record, time and again, in which it is made clear that regulated monopoly is most desirable.

The irresistible array of arguments in favor of consolidation of hydroelectric utility effort throughout the West is slowly but surely growing upon the public mind and from it will undoubtedly result the grandest and most effective interlinking of co-operative effort ever realized in the history of the electrical industry.

Conserve the Fuel and Safeguard the Service

Attention was called in an editorial of the Journal of Electricity, June 1, 1917, to the necessity of interconnecting transmission lines throughout the West and thus conserve the fuel and safeguard continuity of service. It is gratifying to note that splendid co-operative effort is seen in California and other localities of the West looking toward the fruition of this ideal. The matter has received the serious attention of power plant managers, state councils for defense, the executive officers of the Pacific Coast Section of the N. E. L. A. and the California Railroad Commission. In California it is suggested that a bus line from Redding to Fresno, a distance of about 300 miles be established. This would directly connect the large Pit River development now under way with the group of systems in Central California, and would have sufficient capacity to transfer considerable blocks of energy to or from the Pacific Light & Power Company's Big Creek plant and thus to the Southern California group of companies.

A tie-in at the junction of the Pacific Gas & Electric Company with the Great Western Power Company midway between Marysville and Sacramento and the construction of 25 miles of line between the Sierra & San Francisco Power Company station at Manteca and the Great Western Company station at Isleton would also be an important accomplishment.

This is only one of many constructive moves that might be made in various localities of the West and certainly it is to be hoped that the good work now started will at the earliest possible moment be brought to a concrete reality.

War Policy of Utilities

The Puget Sound Traction, Light & Power Company has formulated a policy to be followed during the period of the war A number of meetings of heads of departments have been held to study the situation which have considered and discussed necessary readjustments of the working force, with a view to making the entire organization helpful to the government, and at the same time keep it as responsive as possible to any demands that may be made for community service.

Preliminary to this work of readjustment a military census of the employes was taken which has placed a fund of information in the company's possession. For instance one line on the census cards notes the former occupations of all the workers. Men who were auto tire makers, bricklayers, ship carpenters, sailors, plumbers, steam fitters or joiners are now trainmen, linemen, collectors, solicitors or clerks. The possession of this information makes it possible for the company to call upon workers within its own organization for almost any needed purpose, which furnishes an elastic, efficient and mobile force.

Another matter to which much attention has been given in these organization meetings is that of load distribution which is to say, of equalizing as far as possible the demands for power for industrial purposes. Conferences have been held with manufacturers to readjust the closing hours and the changes of working shifts. By these means the peak load will be lightened and more current will be consumed during other hours.

The announced purpose of the company is to place itself in readiness for whatever service the government may require, and yet remain responsive to the demands of the communities its properties serve.

The necessity for doing all these things is made plain in a statement by President A. W. Leonard to the public, to public officials and to the officers, heads of departments and employes of the company which appears elsewhere in this issue.

Aside from the lesson of patriotic preparedness suggested in the outline of the policy of the Puget Sound Traction, Light & Power Company during the period of the war, there should be enforced limitation of expenditures for public improvements. Particularly should municipalities be slow to authorize the expenditure of moneys for projects not immediately necessary. The requirements of war finance should take precedent over all other developments.

The co-operation between consumer and central station at Seattle to lessen peak load demands and increase the load factor of hydroelectric plants is highly commendable and should receive similar adoption throughout the West. This is one very important way to serve the national government in its effort to conserve the fuel supply and put the energies of the nation to their best advantage.

Arizona Power Earnings Increase

The surprising development of the Southwest has been a source of much interest in financial and hydroelectric circles for many months past. Not only has this been true for the district in and about Los Angeles, but the interior states of Arizona and New Mexico have been coming to the front in a manner that can not fail to bring forth the commendation of all well-wishers of the West.

The great power plant at Ajo, Arizona, and the plant of the Inspiration Copper Mining Company are today establishing new records in efficient engineering practice. At Ajo, for instance, steam is being generated under 250 lb. pressure, thus establishing a new record for Pacific Coast practice.

In financial matters, too, these great commonwealths are coming to the front. Take, for instance. the recent showing of the Arizona Power Company. For March, 1917, the Arizona Power Company reports gross earnings of $36,961.14, an increase of 70 per cent, when compared with the same month in 1916, with net earnings of $25,841.88, or 73.1 per cent better than for March of last year. The operating ratio for the two periods was 30.1 and 31.5 per cent, respectively. For the twelve months ended March 31 last gross was $357,573.20, compared with $231,775.72 the year before, with net of $94,039.24, against $39,374.58, and an operating ratio of 32.1 per cent, or only 1.9 per cent greater than in the period before mounting costs became so noticeable. The results in March of this year indicate that the company has been able to control costs and henceforth operating expenses should decline, as there is an increasing demand for the power generated at its two hydroelectric plants, particularly from the mines around Jerome, Phoenix and adjacent camps, where operations are showing an increase. Through a subsidiary, the Prescott Gas & Electric

Company, Arizona Power also supplies gas and electricity for power and light to Prescott

Arizona has in recent years taken first place in copper production of the United States, having passed the great treasure state of Montana in this regard some years back. Meanwhile its agricultural development is fast gaining in productive results, and never before in its history has the general stability of this commonwealth been on a better footing.

The Great Awakening in the Northwest

For some time back those who have been in close touch with financial and industrial matters in the Northwest have noted with increasing satisfaction the renewal of business activity on all sides. Some details of this activity along electrical lines will undoubtedly be of much interest to our readers.

Industrial conditions at Portland and vicinity have been greatly improved recently as a result of the activity in ship building and allied industries. The Portland Railway, Light & Power Company has added 4500 kw. in motors and industrial lighting as a direct result. The Northwestern Electric Company reports a corresponding increase in electrical installations and a large extension in their district steam heating system as a result of the advancing prices of fuel oil.

The North Coast Power Company has met with such success in supplying reclamation districts in flooded lands north of the Columbia River that it contemplates an ultimate diking and reclamation of nearly 60,000 acres. Another feature of interest in this territory is the possibility of using vast areas of lignite in the vicinity of Chehalis, Wash., as the basis for making a water gas which can be readily transmitted to Portland and Seattle. The coal-tar by-products are today equally as valuable as the gas produced.

The Pacific Power & Light Company has started construction on a 62-mile tie line from Pasco to Lind, Wash., which will connect its system with that of the Washington Water Power Company This line will be constructed with sufficient spread of the wires for ultimate operation at 110,000 volts. A No. 0 copper circuit is employed. A new switching station and a 5000 k.v.a. synchronous condenser are also to be installed. This company is also constructing a steel tower crossing of the Columbia River between Hood River and White Salmon. The crossing will be about 1993 ft. in length, the conductor being 5/8 in. plow steel galvanized wire.

The city of Seattle has issued specifications for the construction and delivery to the city of a complete hydroelectric plant as an extension to the municipal electric light and power system. Bids will be received until July 20th. The plans call for 13,000 kw. of continuous energy at an estimated cost of $3,000,000. The successful bidder is to accept the city's 20-year bonds in payment.

The Washington Coast Utilities Company has just been organized by Warner Marshal of Boston, Mass, to operate the properties formerly belonging to the Northwest Electric & Water Works at Montesano and Elum as well as the plants at Arlington, Stanwood, Edmonds and Vashon Island, Wash. Extensive plans have been made for improvement, including the installation of a 500 kw. steam turbo generator at Montesano.

The Olympic Power Company at Port Angeles, Wash., has contracted to furnish 4000 kw. to a new paper mill being built at Port Angeles. As a side light on governmental activity in power installation a trade note is interesting. The Seattle office of Chas. C. Moore & Co. has the contract to install a 200 kw. steam plant for a governmental radio station at Keyport, Wash.

Recent increases in the consumption of power in the vicinity of Seattle have taxed the capacity of the Puget Sound Traction, Light & Power Company. The company is installing a new 15,000 kw. unit in its White River hydroelectric and a 10,000 kw. steam unit at Georgetown. At the present rate of increase this additional power will be needed before the installation can be completed. Especial attention is being paid to secure the co-operation of consumers in reducing peak load demands.

Such beginnings as these presage an unprecedented renewal of hydroelectric activity on all sides. They augur much for increased confidence in industrial and agricultural stability in this great productive section of the United States.

THE NEW JOURNAL SERVICE: It is with deep and heartfelt appreciation that the Journal of Electricity acknowledges the many expressions of commendation that continue to come into the editorial department concerning the ambitious new activities it has undertaken since the first of the year. These letters, coming as they do from presidents of universities, professors of electrical engineering, central station managers and engineers in the highest standing throughout the West, combined with beautiful expressions of approval from manufacturers, manufacturers' agents, and contractor dealers, encourage us to make even more ambitious moves for the coming issues.

C. E. Grunsky, the well-known consulting engineer, will head a department devoted to the discussion of rates which will cover vital points that are now perplexing evaluation experts. A. E. Chandler, of the California Water Commission, one of our best known authorities on Western Water Law, begins a series of discussions with this issue on recent advances in this important branch of technical knowledge so necessary in hydroelectric development of the West. In addition to all these good things a host of other details are now in their planning that will not only maintain this Journal as one of the best published—but it even aspires to become on a plane so unique and so helpful as to be in a class by itself. If you approve of its course and of its ambitions, it most sincerely solicits your continued good will and expressions of appreciation.

PERSONALS

John B. Miller, president of the Southern California Edison Company, has recently returned from Washington, D. C., where he had been summoned by President Wilson to assume the enormous task of organizing the finances of the American Red Cross in the territory west of the Mississippi and extending from Canada on the north to Mexico on the south. The members of the electrical industry of the West are proud of the loyal activity shown by its members and it is with a source of personal pride that each is following the notable results that are being accomplished under the leadership of Mr. Miller.

H. S. Hartzell of Baker-Joslyn Company of San Francisco, has recently been at Seattle.

W. A. Brackenridge, vice-president and general manager of the Southern California Edison Company, is in the East.

J. L. Husman, superintendent of the San Francisco branch of the American District Telegraph Company, is at Seattle.

Oswald West, ex-Governor of Oregon, has been appointed receiver of the Home Telephone & Telegraph Company at Portland.

H. L. Vorse, electrical inspector of the Oregon Insurance Rating Bureau, is making an inspection trip in and about the city of Klamath Falls.

William M. Strong, of Denver, Colorado, is resident engineer for the Arnold Company in charge of hydroelectric surveys near Sultan, Washington.

A. M. Sherwood, Jr., formerly of the General Electric Company, Portland, Oregon, has resigned to become president of the Coast Ship Building Company, Portland, Oregon.

F. D. Weber, electrical engineer of the Oregon Insurance Rating Bureau of Portland, Oregon, and Portland representative of the Journal of Electricity, was a recent Seattle visitor.

E. W. Moreland, who has been with the Oregon Public Service Commission for four and a half years as engineer in the department of railways, left the service recently by resignation.

C. E. Grunsky, Jr., recently commissioned captain in the Engineer Officers' Reserve Corps, is now actively engaged as chief of construction in building the new cantonment near San Diego, California.

Geo. Brown of Chelan, Wash., has been superintending the affairs of the Wenatchee Gas & Electric Company of Wenatchee, Wash., since the death of Arthur Gunn, which was announced in the last issue of the Journal.

Carl E. Johnson, manager of the U. S. Electrical Manufacturing Company of Los Angeles, is back again in Los Angeles after an enjoyable honeymoon trip by automobile up through California to San Francisco, thence by boat to Seattle and Portland.

C. E. Stevens, manager illuminating section of the supply division of the Westinghouse Electric & Manufacturing Company, and **L. A. S. Wood,** special representative of the Geo. Cutler Company, have been in California, Oregon and Washington during the past two weeks.

Clyde A. Malone of the California-Oregon Power Company has been ordered into the training camp as a captain of the coast artillery.

R. M. Boykin, engineer for the North Coast Power Company of Portland, Ore. has been elected vice-president and appointed general manager of the company following the resignation of H. L. Harries, who is at the military training camp at the Presidio.

Robert Sibley, editor of the Journal of Electricity, as guest of honor recently addressed a gathering of some sixty young engineers in Berkeley, California, on the present opportunities of service for the engineer. Among the group were many of his former students.

B. M. Woods, assistant professor of theoretical mechanics, and **B. F. Raber,** associate professor of mechanical engineering at the University of California, have returned from a governmental commission to Toronto and are assisting in instituting a curriculum on military aeronautics at the State University.

B. W. Collins, manager of the Montesano plant, recently acquired by Warner Marshal of Boston, Mass., now represents Mr. Marshal, while **F. D. Nims,** formerly engineer and assistant general manager of the Olympic Power Company, has also joined the Marshall organization and is expected to return to Seattle about July 1st.

Lewis Linn McArthur, son of general manager Lewis A. McArthur, is the latest acquisition to the managerial force of the Pacific Power & Light Company of Portland. From latest reports it would appear that this little nine-pounder is adding his quota in building up the splendid esprit de corps of this organization.

George A. Damon, dean of engineering at Throop College of Technology, has submitted a comprehensive plan for San Jose's transportation problems. The plan takes into account the coming electrification and joint operation of all railroad lines into the city and provides for its social, religious and educational growth.

A. H. Griswold, plant engineer for the Pacific Telephone & Telegraph Company, has received a commission as major in the Engineer Reserve Officers Corps and has left for Monterey, Cal, to receive preliminary training in order to prepare for an early departure to France to serve in the signal corps of the U. S. Army.

Samuel Insull, president of the Commonwealth Edison Company of Chicago, received the honorary degree of Doctor of Science at the one hundred and twenty-first commencement exercises of Union College, Schenectady, N. Y., held June 11th to 13th, 1917, in token of his work as an organizer and administrator, successful in establishing a vast industry.

W. D'A. Ryan, illumination engineer of the Panama-Pacific International Exposition at San Francisco in 1915, has contributed a noteworthy paper to the American Institute of Electrical Engineers on the lighting effects of the exposition. The unique and interesting feature of the paper is the series of beautiful colored plates that are exhibited, showing in many details the gorgeous and inspiring night views that were the subject of such world-wide comment during the exposition and which have since ushered in a new era in electrical illumination. The colored plates are being sent out with the June proceedings of the American Institute of Electrical Engineers.

John A. Britton, vice-president and general manager of

the Pacific Gas & Electric Company, in addition to his present duties on the California State Council for Defense, will also serve on the national committee on gas and electric service of which **John W. Lieb** of the New York Edison Company is chairman. The committee is recognized by the Advisory Commission of the Council of National Defense as one of its advisory committees, and it has established an official headquarters in the Munsey Building, Washington, D. C.

George C. Holberton of the Pacific Gas & Electric Company; **Col. H. V. Carter,** formerly president of the Pacific States Electric Company; **T. E. Bibbins,** president of the Pacific States Electric Company; **W. S. Berry,** Western sales manager of the Western Electric Company; **E. . Cutting,** Western manager of the Edison Storage Battery Supply Company; **Lee H. Newbert** of the Pacific Gas & Electric Company; and **R. M. Alvord** of the General Electric Company, all of whom are past presidents with the exception of Mr. Alvord, who is the present active president, made beautiful and stirring addresses at a recent meeting of the San Francisco Electrical Development & Jovian League in which the possible patriotic effort of the league in the national crisis was most forcefully brought out.

J. D. Galloway, a consulting engineer of San Francisco, has been appointed chairman of a committee on engineering and inventions for the California Council of Defense. Other engineers on the committee are **George A. Damon,** dean of engineering, Throop College of Technology; **G. W. Dickey,** consulting naval architect; Frank Rieber, chief engineer Rieber laboratories; **C. L. Cory,** professor of electrical engineering, University of California; **C. R. Weymouth,** chief engineer Chas. C. Moore & Co.; **Harris J. Ryan,** professor electrical engineering, Stanford University; **Guy Bailey,** consulting engineer; and **Dr. Thomas Addison,** Western manager of the General Electric Company.

OBITUARY

Frank L. Stearns, electrical engineer for the Chicago, Milwaukee & Puget Sound electrification, died recently as the result of inhaling gas and smoke caused by the burning of insulation in the substation of the East Portal of the long tunnel of the company in western Montana.

NEW BULLETINS

The V. V. Fillings Company of Philadelphia have just issued a pamphlet on safety first switches.

"Gifts Electric" is the pleas'ng title of an artistic and helpful suggestion booklet just issued by the National Electric Light Association.

Progress in water works pumps is set forth in a recent attractive forty-eight page booklet by the De Laval Steam Turbine Company of Trenton, N. J.

The latest pamphlet illustrating the No. 318 Simplex Pole Jack shows this efficient pole puller in actual operation together with other useful information.

"Home Sanitation' is the title of a leaflet issued by the United Electric Company of Canton, Ohio, setting forth advantageous use of the electric cleaner.

"Keep Business Going," is a new leaflet issued by The Society for Electrical Development, Inc., to assist in bettering business for the entire electrical industry.

The Electrical Utilization Safety Orders issued by the Industrial Accident Commission of the State of California have been revised as of date July 1, 1917, and are now on distribution.

The embrittling action of sodium hydroxide on soft steel by S. W. Parr is the subject matter of bulletin 94 just issued by the engineering experiment station of the University of Illinois.

The Western Electric Company has issued a most attractive pliable bound series of leaflets on window display service that will aid the contractor and dealer immensely in properly marketing their goods.

"Reforestation on the National Forests" is the title of bulletin 475 of the Department of Agriculture. This bulletin should prove very helpful to hydroelectric companies that have large water sheds to safeguard.

The U. S. Electrical Manufacturing Company of Los Angeles has issued a large leaflet describing a self-contained motor-driven grinder which should be of interest to all interested in an electric grinding and buffing tool.

"New and Used Machinery" is the title of a thirty-page pamphlet by Gray and Barash of Seattle, Washington. In this publication useful information is given along electrical and hydraulic lines for purchase and sale of such machinery.

The General Electric Company has issued two-color leaflets on "Individual vehicle taper charging set with automatic panel"; "Tungar Rectifier," a new battery charger for use with alternating current; and "Small battery charging outfits."

The Union Electric Company of St. Louis has published a most attractive booklet 7 by 16 inches on the subject of electric service editorials that set forth the strong features of the public policy of that company in dealing with its consumers in St. Louis.

In line with the aggressive activities of the Society for Electrical Development, Inc., to help build up better advertising and merchandising methods for its members, it issues a monthly sales service. This service has been a decided hit since its inauguration in February. Each sales service is different from the other and the aim is to put into this service only material that will interest all, or nearly all, of the electrical businesses, such as manufacturers, central stations, jobbers and dealers.

BOOK REVIEWS

Examples in Battery Engineering. By Professor F. E. Austin. Size 5 by 8 in.; 90 pp.; 40 illustrations; cloth binding. Published by the author and for sale at the Technical Book Shop, San Francisco. Price $1.25.

The increasing use of primary and storage cells at the present time, and the greatly extended applications possible in the future, is a valid reason that engineering students as well as those engaged in professional practice should have adequate knowledge of the fundamental principles forming the foundation of "battery engineering."

This little book is divided up into sixteen lessons on all the important phases of battery engineering and closes with a list of helpful references. Some twenty odd examples are completely solved. Illustrations and tables assist the reader in getting a grasp of the subject. This simpe little book should appeal to all those having to do with this new and growing departure in electrical science.

Electric Railway Transportation. By Henry W. Blake and Walter Jackson. Size 6 by 9 in.; 487 pp.; 120 illustrations; cloth binding. Published by McGraw-Hill Book Company of New York City and for sale at the Technical Book Shop, San Francisco. Price $5.00.

Here is a book on transportation methods and practice of electric railways. Since men engaged in the transportation department of an electric railway greatly exceed in number those in the engineering department, and the opportunities for financial loss through faulty practice are at least as large if not larger, this work should fill an unusual mission in the electric railway field. The authors who are editor and manager, respectively, of the Electric Railway Journal, have had wide and varied opportunities in collecting data for this book. The chapter on freight and express business should prove especially helpful to engineers and traffic managers throughout the West as the need for increased business along these lines is growing in importance each day.

MEETING NOTICES FOR ELECTRICAL MEN

(The one meeting of the immediate future upon which all eyes are fixed is that of the convention of The California Association of Electrical Contractors & Dealers at Santa Cruz, July 11-14, 1917. Not only are the contractors themselves enthusiastic over its success but jobbers and central station men are actively assisting in making the meeting an unpre-cedented success. Of the meetings recently held in various districts of the West that of the Pacific Gas & Electric Employes Association in San Francisco, and the Pacific Coast Gas Association in Los Angeles have proved immensely helpful and inspiring. The reorganization of the Southern California Edison Company still holds the attention of the western hydroelectric fraternity. Other meeting notices will also be found in the following lines.—The Editor.)

California Association of Electrical Contractors & Dealers

The great event of coming interest in Central California during the coming semi-monthly period is the annual convention of the California Association of Electrical Contractors and Dealers. The convention is to be held at Santa Cruz, July 11-14, 1917.

It is anticipated between three and four hundred will be in attendance. From reports so far received from various parts of California, it would seem the above estimate is not far out. Contractors and dealers from the Sacramento and San Joaquin Valleys have expressed their intention of being present. Southern California is to send a delegation, while the cities of Stockton, Santa Rosa, San Mateo, and many others, will be represented.

Representatives of central stations in various parts of the state of Nevada, as well as many Electrical Supply Jobbers, are to be on hand.

Program

Wednesday, July 11, 2:30 p. m.
Opening of the Convention.
Reports of officers and standing committees.

Thursday, July 12, 9:00 a. m.
"Engineering Features of Electrical Construction as applied to Contracting"—paper by Mr. C. F. Butte.

2:00 p. m.—"Retailing and Merchandising"—paper by Mr. L. Levy, followed by a practical demonstration on "Constructing a Newspaper Ad" by H. W. Lemmon, of the Truckee River General Electric Co., Reno, Nevada.

Mr. Lemmon is a graduate of the newspaper world and eminently fitted to show the retail man some points in preparation of advertising copy for newspaper use.

Friday, July 13, 9:00 a. m.
"The Business Phases of Electrical Contracting," by Mr. H. C. Reid.

After a discussion of this subject, Mr. C. C. Staehling will set forth "Some of the Essentials of Cost Accounting," treating in detail the subject of "Overhead" and "Depreciation." If you don't know what Overhead is, or think you have only a small one, and Depreciation does not come your way, just attend this session and see where you stand.

Saturday, July 14.

8:30 a. m.—Election of officers.

1:30 p. m.—An open session. Addresses by various leaders in the electric industry. At this session, Mr. Albert Elliot will talk on "The Electrical Contractor, East and West." Mr. Elliot has just returned for an extended trip throughout the East, during which time he was in direct touch with the Eastern electrical men, and will tell you first hand of conditions as he saw them.

7:00 p. m.—Annual Banquet.

The ladies are expected to be present this year and ample provision has been made for thier entertainment under the able direction of the entertainment committee. There will be a swimming contest; night on the beach, with entertainment and refreshments; an afternoon at the Big Trees in which all are expected to join; games, races, open-air dancing, etc.; an open to all dance Wednesday evening, and the regular Association Ball, Thursday evening at the Casino Concert hall. There is going to be lots of opportunity for swimming, fishing and golfing, so come prepared.

The convention committee consists of Mr. M. A. De Lew, chairman; Messrs. T. Bennett, E. E. Brown, W. E. Hayes, H. C. Reid. The entertainment committee: T. Bennett, M. L. Scobey, J. W. Asher, A. E. Rowe, M. S. Orrick. The program committee: H. C. Reid, C. B. Kenny, H. W. Kimball, R. E. Fisher, C. A. Parmelee, R. L. Cardiff, M. A. Cain, W. Cox, J. C. Geyer. Ways and means committee: E. E. Brown, C. F. Butte, P. Decker, L. Levy, H. P. Stowe.

BUILDERS OF THE WEST—VIII

M. M. O'SHAUGHNESSY

The growth of an empire is largely measured by the breadth of vision displayed in the building of its great municipalities. The material engineering accomplishments in the erection of dams that to the beholder almost pierce the very sky above, or in the driving of tunnels that establish records in municipal attainment hitherto unaccomplished in municipal effort, attract the eye and call forth the admiration of all beholders. But to M. M. O'Shaughnessy, city engineer of San Francisco, this issue of the Journal is dedicated not so much for these actual material accomplishments as for that breath of vision possessed by this builder which gives to the younger generation such an inspiration for higher actions.

San Francisco Electrical Development & Jovian League

The League meeting for Wednesday, June 13, was given over to a discussion of the submarine menace under the leadership of Lieutenant Howell, U. S. N., now superintendent of the National Ice Company in San Francisco. The members were told in a most entertaining and interesting manner just how the submarine is built, how it operates and what the chances are of its being put out of commission.

On Wednesday, June 20th, C. F. Stern of the California Highway Commission spoke of the magnificent system of highways that have been built in California at a cost of thirty-three million dollars and referred in a forceful manner to the splendid fruitage that is now the heritage of the people of the state in the resultant spirit of neighborhood feeling and co-operation in all communities of the state. A. Youngholm of the Electric Railway & Manufacturers' Supply Company acted as chairman of the day.

The last meeting of the League for the spring season, a thoroughly representative gathering, was held June 27. It was one long to be remembered. All the presidents from the incipiency of the League some six years back, were either present in person or by proxy. Patriotic remarks were the order of the day. It was voted that a committee be appointed to keep in touch by correspondence with all League men entering the national service.

The Red Cross Committee reported that the five hundred dollar pledge of the society had been more than met in the nature of five hundred new memberships. The meeting adjourned with three rousing cheers for Captain Baker, and Captain Malone, who were present for perhaps their last time before leaving for France.

Pacific Service Employes' Association Banquet

The Palace Hotel on the evening of June 14 was a brilliant affair with over 600 employes of the Pacific Gas & Electric Company present. It was a most patriotic evening, in which all sang the national airs. The original song "We Will Stand by Uncle Sam," composed by H. J. Ridgway of Marin district, was one of the hits of the evening. Interesting tableaux showing the spirit of 1776, 1861 and 1917 were given, the success of which is largely attributable to the energetic work of R. E. Fisher. Remarks were made by Henry Bostwick, chairman of the association, and A. F. Hockenbeamer. Attorney General U. S. Webb, ably introduced by Senator Cutten, gave an intensely interesting summary of relations between public utilities and the American people.

J. A. Britton in his characteristically able manner reported on his recent trip to the national capital, and the progress made in obtaining government permission for utilizing hydro power.

The New Southern California Edison Company

The total capitalization of the enlarged Southern California Edison Company is now approximately $77,000,000—divided into $38,000,000 of stock and $39,000,000 of bonds, debentures and notes.

With the annexed territory of the Pacific Light & Power Corporation the Southern California Edison Company now serves over one hundred cities, towns and intervening rural communities with a population of approximately 1,250,000. It has 175,000 consumers and operates the following properties.

16 Hydroelectric plants of 156,500 h.p.
8 Steam plants of 141,770 h.p.
138 Substations.
1232 Miles 150,000 volt transmission tower lines.
188 Miles 60,000 volt steel tower transmission lines.
1608 Miles other transmission lines.
5213 Miles distributing lines.
2 Gas plans of 1,650,000 cubic feet daily capacity.
101 Miles of high pressure gas mains.
9 miles of electric street railway.
56 Miles steam railroad.

The vast geographical domain touched by the greater Edison system and in which electricity is generated and sold, includes the entire territory of Southern California and in addition, the great kingdom of the San Joaquin Valley, now only in the early stages of development.

The territory in which electricity is now distributed for light, heat and power purposes aggregates 43,978 square miles in ten counties, or more than the combined area of Massachusetts, New Hampshire, New Jersey, Vermont, Rhode Island, Delaware and Connecticut. In this enormous field there is almost infinite possibilities for productiveness by the application of electricity to agriculture, manufacturing and the domestic uses, which bring living up to the highest standard and accelerate the growth of cities and towns and populate with prosperous homes the intervening farm lands.

To make this splendid region respond to the electric thrill and to make it intensely electric is the magnificent opportunity for the men of the greater Edison.

It has been officially announced that it will be the policy of the company to reckon the terms of service of the men who come into the Edison organization, from the Pacific Light & Power Corporation from the time they entered that service, the same as in the case of the original Edison employes. In this spirit the new men enter the organization to co-operate with their associates in the big task that is before them all.

About six years ago the company, on account of its increasing size, found it necessary to add to its general offices. This was accomplished by leasing an entire floor in the San Fernando Building which is adjacent to the Edison Building. At that time it seemed that this additional office room would provide for the growth of the company for practically an indefinite length of time. However, after this comparatively short time the company is again compelled to seek additional accommodations. The old Edison Building is now only of sufficient size for the administrative, legal, general agent, treasurer and accounting departments, including also the Los Angeles district business office. The rooms in the San Fernando Building now house the operating, engineering record, purchasing and inventory departments.

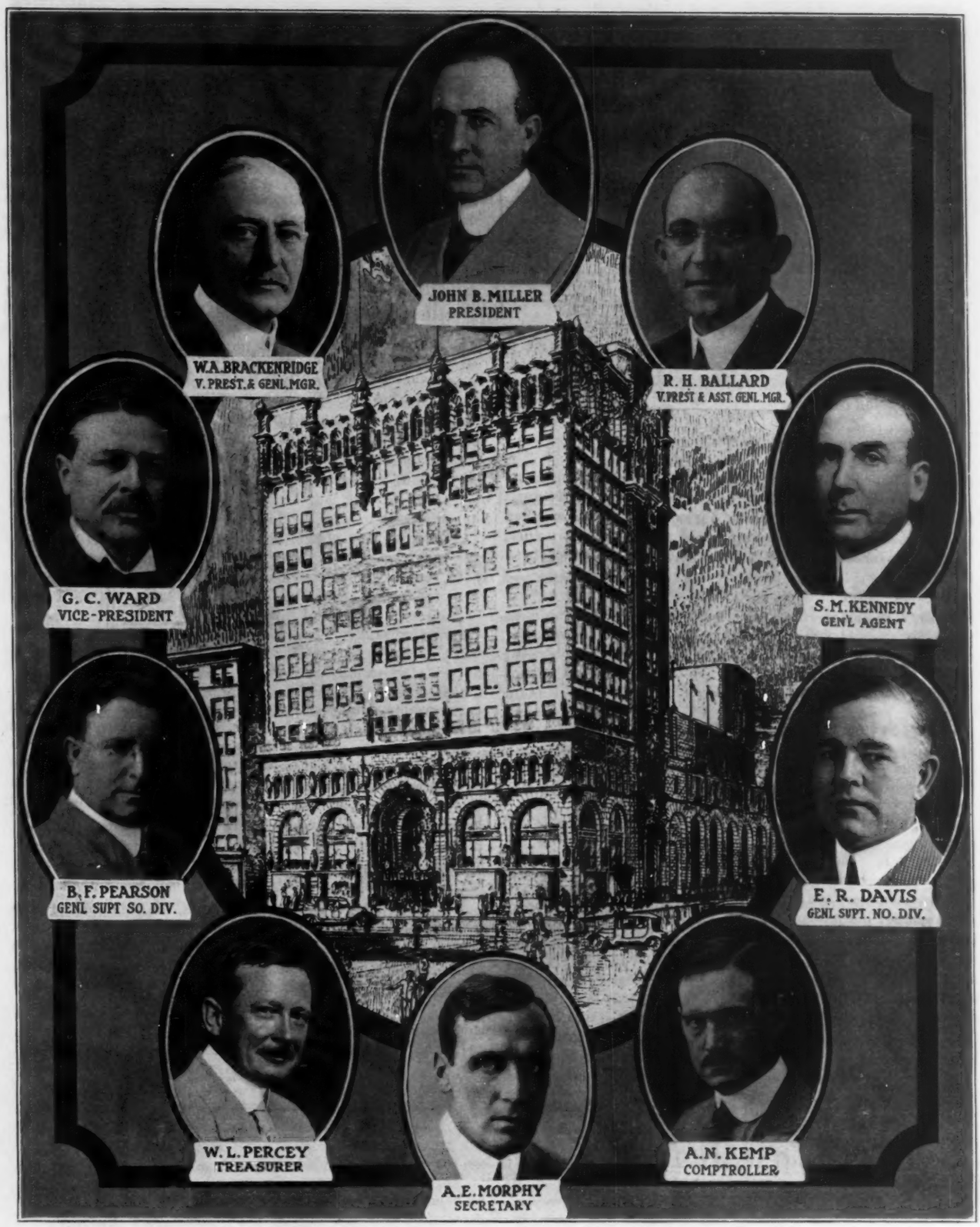
The new structure which is to form the future home of the Southern California Edison Company is located at the southwest corner of Third street and Broadway, Los Angeles. This building will occupy 120 ft. on Broadway and 194 ft. on Third street. The entire first floor will be given over to a large modern theater with a seating capacity of 3000. The portion of the building fronting on Broadway will be carried to a height of twelve stories and it will be the top eleven floors of this section that will be occupied by the company. As each floor will have an area of approximately 5200 square feet it is seen that these new accommodations will be ample to care for the company's present needs, leaving a considerable margin to take care of the future growth that is certain to come. This building was commenced under the name of the Stability Building, but since the leasing of practically the entire office space by the company, it has very appropriately been decided to abandon the original name and call the new structure the Edison Building.

In its structural features the New Edison Building will be strictly fireproof in every respect. It will have a steel frame thoroughly fire-proofed by concrete; the floors, partitions and walls being reinforced concrete. The exterior will be after the ornate Spanish Renaissance order, the face being of variegated tapestry brick and old ivory terra cotta. The cornice will be capped with eleven revolving electric flambeaus. The entrance to the company's quarters will be on Third street where there will be a handsome marble vestibule and lobby. In this lobby will be located three modern high speed electric elevators, serving the floors above.

In the arrangement of the various offices of the departments and also in the relative location of the departments, every thought is being given to obtain a layout that will make for the greatest possible convenience and efficiency. On the top floor will be located the president's offices with the legal department, and a spacious directors' room adjoining. On the floor below will be the offices of the general manager, the vice-presidents, the comptroller and the secretary. The accounting, operating and engineering departments will each occupy an entire floor.

All interior partitions are to be made of clear plate glass above a height of three feet so that the one in charge of the department will at all times have in view all of the men under him. The floors of the offices will be covered with cork linoleum, while the corridor floors will be of marble. All floors will have suitable locker rooms and lavatories and will be supplied with steam heat, hot and cold water, etc.

In the illumination of both the interior and exterior of the building, no effort will be spared to make it perfect in every respect. The interior lighting will be indirect and will be so designed that a uniform intensity of light, practically without shadows, will be obtained at all points. The entire exterior of the building will be flood lighted, the details of the system being worked out on a scale never before attempted. In this connection it is interesting to note that plans are now under way for the illumination of Broadway. These plans are being worked out along the lines followed in the lighting of Market Street, San Francisco's "Path of Gold." When completed, the Broadway lighting will far surpass anything else of its kind and it is very fitting that the new Edison Building will be its best lighted edifice.



THE OFFICERS OF THE REORGANIZED SOUTHERN CALIFORNIA EDISON COMPANY

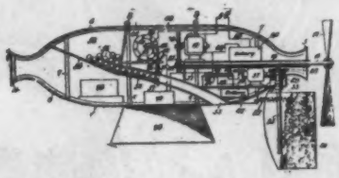
Here is a group of leaders in utility thought in Southern California, encircling the beautiful new building of their company. With its twelve hundred miles of 150,000 volt transmission tower lines, its eight steam plants of over one hundred and forty thousand horsepower, its sixteen hydroelectric plants of over one hundred and fifty thousand horsepower, and its splendid personnel in the way of executive talent, this organization presents to the hydroelectric fraternity of the nation an unusual and striking setting.

WHAT WESTERN INVENTORS ARE DOING

(The utilization of the earth's field of magnetism has long been the dream of inventors. Below is a brief setting forth of a recently invented aerial torpedo wherein means are provided for responsive directorial effort from the earth's magnetization in order to maintain a predetermined course for a torpedo. Other inventions are an automatic block signal apparatus, a dynamometer, an automatic circuit-closer for electric heaters and a train-stopping apparatus.—The Editor.)

1,228,281. **Aerial Torpedo.** Clarence Barrett, Salt Lake City, Utah, assignor, by direct and mesne assignments, of one-third to George Morrow and one-third to Robert W. Salisbury, Salt Lake City, Utah.

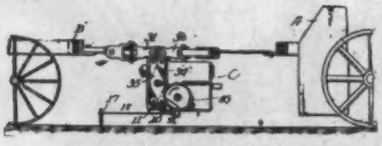
An aerial torpedo provided with means for sustaining it in the air, means for propelling the torpedo structure pro-



gressively, means responsive to earth magnetism for maintaining a predetermined course of the torpedo structure, means for releasing destructive devices at a predetermined point in the progressive movement of the torpedo structure, and means for causing the destruction of the torpedo structure.

1,228,299. **Dynamometer.** Jay B. Davidson, Davis, Cal.

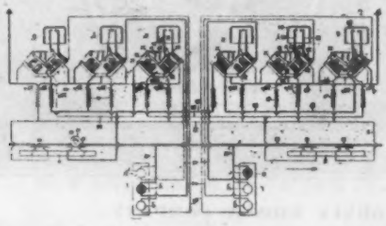
A dynamometer comprising two separate parts, means for resisting separation of the parts, a recorder mechanism ar-



ranged for movement in accordance with the distance of dynamometer travel, a co-operating recorder mechanism for movement in accordance with relative displacement of the parts, the mechanism co-operating to record the operation of the dynamometer, and means for automatically actuating the first recorder mechanism through a predetermined distance of travel.

1,228,168. **Automatic Block-Signal Apparatus.** Virgil Webb Baumgartner, Salt Lake City, Utah.

The combination of track rails, with a block signal system independent of the track rails and comprising a clear signal at the entering end of the block and a clear and a danger

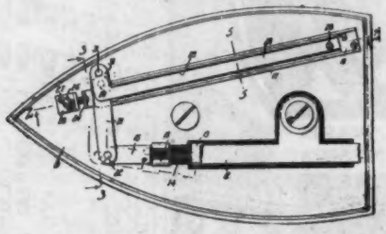


signal at the leaving end of the block, a switch for each

A dynamometer comprising two separate parts, means for closing the clear signal switches as a car is leaving the block for setting clear signals, electrical means for closing the danger signal switch and opening the clear signal switches as a car enters the block, whereby a danger signal is given at the far end of the block, each switch including an electromagnetically operated movable contact for opening the switch ,and an electrically operated lock movable to and from a position for holding the movable contact in open position.

1,228,195. **Automatic Circuit-Closer for Electric Heaters.** Michael Hough Farley, Seattle, Wash., assignor of one-half to Arthur W. Kah, Seattle, Wash.

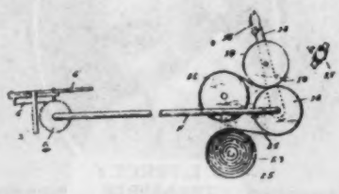
A thermostatic circuit closer, the combination of relatively fixed and movable contact members, a lever having longer and shorter arms, the longer arm being connected to



the movable contact member, a pair of expansion members arranged parallel to each other, one of the members being anchored at one end and the other member being anchored at its opposite end, and means to connect the otherwise free ends of the expansion members to the lever whereby the effect of the expansion of one member acting upon the lever will be added to that of the other expansion member.

1,227,866. **Train-Stopping Apparatus.** Aden M. Worden, Phoenix, Ariz.

Automatic train stopping apparatus, the combination with a valve connected in the brake pipe and normally closed, of a lever capable of swinging movement toward the valve and adapted to engage the valve to open the latter, a shaft, a connection between the shaft and lever whereby the latter



may be swung in the rotation of the shaft and operable to disconnect the lever from the shaft so that the lever may be restored to normal position, driving connections between the shaft and one of the drive wheels of the engine whereby the shaft will be rotated at less speed than the drive wheel of the engine so that the lever may be swung to open the valve after the train has traversed a prescribed distance.

NEW ELECTRICAL DEVELOPMENTS

(The most important new electrical development of the past semi-monthly period is the announced intention of the Pacific Gas and Electric Company to proceed to the construction of the rather unique power plant at the outlet of the Spaulding Dam. This power house will develop some 5000 horsepower and the head under which it will operate will be variable, depending upon the height of water impounded in the great Spaulding Lake, thus overcoming a hitherto unencountered variable in power development. Other items of interest follow.—The Editor.)

FINANCIAL

OAKLAND, CAL.—An offer of $850 by the attorneys for the Great Western Power Company, to compromise the city of Oakland suit for delinquent franchise tolls of $100,000 has been received by the city council of Oakland.

ANDERSON, CAL.—At a meeting the directors of the Anderson-Cottonwood irrigation district announced that the irrigation bond issue of $575,000 had been duly validated, although no written notice has been received by Secretary Earl Downing. It developed the directors will not immediately sell the full issue, but will sell about $350,000 for immediate use. This amount it is expected will be available between July 1 and 10.

LASSEN, CAL.—The board of directors of the Baxter Creek Irrigation District has ordered the issuance of bonds in the sum of $310,000, and to publish sale of the same on July 2, 1917. Chief Engineer H. S. Martin will shortly have contracts for construction of the dam and canals ready for publication for bids. H. S. Martin, is chief engineer, Arad Way, assessor, and T. T. Gross, secretary of this pioneer district east of the Sierras.

SALEM, ORE.—The Public Service Commission recently issued the second of its orders covering rates on the Portland Railway, Light & Power Company, this order affecting the rates on commercial lighting and heating. The preceding order covered residence lighting and commercial power business.

Under the order issued today the rates of the company on those classes of business are decreased approximately from 5 to 10 per cent the order to become effective July 1. If the Northwestern Electric Company meets the reductions under the new order, as it met the reductions under the former order, it will not cause any material difference in the total revenues of that company, but will provide for an increase in some instances and a decrease in others to the customers of the Northwestern.

INCORPORATIONS

HANFORD, CAL.—The Laton Telephone Company of Hanford has been incorporated for $10,000 by I. Tielman, T. D. Marshall and A. G. Smith.

SEATTLE, WASH.—The Canadian Electric Gun Company has been incorporated with a capital stock of $150,000, by C. V. Winberg and T. J. Acheson.

SAN FRANCISCO, CAL.—The Taye Company has been incorporated for $20,000 by A. E. Anderson 198 shares, and A. O. Dorey and W. H. Thormley 1 share each.

LOS ANGELES, CAL.—The Little Grant Heating and Lighting Company of Los Angeles, has been incorporated for $100,000 by S. V. Halstead, D. S. Collins, A. L. Davison, G. H. Reimer and J. R. Edwards.

CORONA, CAL.—The Twin Buttes Water Company has filed articles of incorporation in Los Angeles with a capital of $750,000. The company is composed of W. J. Hole and Samuel K. Sameson of Los Angeles, and T. C. Jameson, R. W. Voris, W. P. McClaskey, G. R. Freeman and Isabello Sargent of this city. The company has been formed for the purpose of supplying irrigation water for the 500 or more acres known as La Sierra Rancho, owned by W. J. Hole.

ILLUMINATION

OAKLAND, CAL.—The board of public works would install a lighting system in San Antonio Park at a cost of $1500.

FRESNO, CAL.—The cost of installing an electrolier system on J street between Inyo and Los Angeles streets will be $7194.

RIVERSIDE, CAL.—A contract for the installation of an ornamental lighting system on Main street from Tenth to Fourteenth street has been let to D. A. Tamplin on a bid of $1925.

SANTA MONICA, CAL.—Bids have been received by the city council for lighting of Second street. They were: J. L. Wilson, $1500; D. S. McEwan, $1207; D. A. Tamplin, $1377; Redondo Construction Company, $1400.

LOS ANGELES, CAL.—The board of public works will receive sealed bids at the office in the city hall on or before June 22d for lighting of the San Pedro district for a period beginning July 1, 1917, and ending June 30, 1918.

RICHMOND, CAL.—To place electroliers on Macdonald avenue from First to Twenty-third street and to make the street as attractive as its importance demands, a new campaign for lighting has been inaugurated. The lighting committee has been appointed to meet with D. J. Collins and other interested merchants and Macdonald avenue property owners.

SAN DIEGO, CAL.—Reclamatilon of 732 acres of tide lands bordering Dutch Flats, which will be used as a site for a marine brigade post, is to be started before the end of the month, it is stated. The sum of $600,000 has been appropriated for construction of sewers, water and lighting systems. A total of $5,000,000 it is estimated, will be spent in the construction of buildings and wharfs and for shipment of these structures.

RIVERSIDE, CAL.—The city council has decided to take over the work of installing the ornamental lighting system on Main street, between Tenth and Fourteenth streets. The contract was let to D. A. Tamplin of Los Angeles on his bid of $1925. The city's bid arrived at the meeting just one minute too late to be considered, but as it was considerable lower than that of the Los Angeles man, it has been decided to revoke the award of contract and authorize the city to do the work.

TRANSPORTATION

SALT LAKE CITY, UTAH.—Electrification of the Saltair, Garfield and Western Railroad will start soon, the company having $50,000 on hand for the work.

RICHMOND, CAL.—The city council has been instructed to confer with the Southern Pacific Company relative to a proposed electric franchise held for Cutting boulevard. The company was supposed to start an electric line on the boulevard some time ago.

SAN PEDRO, CAL.—Surveys are being made by the Pacific Electric Company of the Barton Hill district looking toward the carrying of the Bandino street line to a joining place with the Gardena line at some point near Pacific avenue junction. It is believed that the building of the new road will not be delayed.

GLENDORA, CAL.—The Pacific Electric Railway Company last week was surveying a route between Glendora and San Dimas for the extension of the Glendora line to make connection with the Los Angeles, Pomona and San Bernardino through line at San Dimas. Our information is that the Pacific Electric officials will push the project to completion with as little delay as possible.

SAN FRANCISCO, CAL.—Municipal Railway cars are expected to be running through Twin Peaks tunnel by the first of the new year. The board of public works has called for bids for the construction of the line from Market and Castro streets through the big bore to Sloat boulevard, a distance of more than three miles. The cost will be approximately $45,000 for the trackage alone, and the work must be completed in five months.

SEATTLE, WASH.—Orders of the Washington State Public Service Commission requiring the Puget Sound Traction Company to run through cars on its Ballard Beach line in Seattle and increase passenger seating capacity on the Alki Point and Fauntleroy Park lines were in effect sustained and made operative recently by the supreme court, which affirmed dismissal of the traction company's suit to enjoin the orders, alleged to be unreasonable and confiscatory.

LOS ANGELES, CAL.—Plans that will mean millions of dollars to Los Angeles have been agreed upon by officials of the Pacific Electric Railway Company. The plans are for the building of street and freight cars at the new $1,000,000 shops of the company at Torrance. The first order will be for 200 freight cars, costing about $1000 each. After they are completed street cars and interurban passenger coaches will be constructed, these ranging in cost from $10,000 to $20,000 each. The decision to build cars in Los Angeles has caused extensive alterations in equipment of the plant at Torrance, and it is probable that the cost will exceed the original estimate of $1,000,000.

TRANSMISSION

OKANOGAN, WASH.—The Okanogan Valley Power Company of Brewster, it is reported, will rebuild its distributing system within the corporate limits of Okanogan.

KINGMAN, ARIZ.—Tennaut & Sladek have secured the contract for the new office and transformer building that is to be erected by the Desert Power & Water Company at Chloride.

COQUILLE, ORE.—Manager F. E. McKenna of the Oregon Power Company, announces that work will be begun on the construction of a power line from Marshfield to this city. The cost will be about $25,000.

NEWPORT, WASH.—The Northern Idaho & Montana Power Company is erecting a 11,000 volt, three-phase, 60 cycle transmission line from Newport to Dalkena, Wash. The transformer station will have an initial capacity of 300 k.v.a.

SEATTLE, WASH.—The date for opening bids for the furnishing of a 500 kw. motor generator at Aloha street substation and four oil switches at the city steam auxiliary power plant has been extended by the board of works, from June 8th to June 22d.

CHLORIDE, ARIZ.—F. W. Wilde Jr. of the Desert Power & Water Company, states that his company will immediately begin construction of a transformer station here. The new station will be of concrete, two stories high and will involve a total expenditure of approximately $12,000.

TACOMA, WASH.—The Wheeler-Osgood Company of Tacoma is planning to equip its sawmill for electrical operation which will increase the output from 150,000 to 170,000 ft. per day. The new equipment will include four 465 h.p. turbines, three boilers, one generator and one turbine. The cost of the work is estimated at $60,000.

SEATTLE, WASH.—Bids will be received by C.B. Bagley, secretary of the board of public works of the city of Seattle, until June 29 for the furnishing of four oil switches for the auxiliary steam electric station at Eastlake avenue and Nelson Place, and two transformers for a substation tie, one between the Seventh Avenue substation and the steam plant.

FRESNO, CAL.—A contract was let by the San Joaquin Light & Power Corporation for the erection of a 250 h.p. reciprocating booster pump station in the vicinity of Taft, Kern County. The station will be located about midway between Taft and Buena Vista Lake and will lift water from a lateral canal to the high lands near Taft. The cost of the plant will be about $50,000.

CHEWELAH, WASH.—The Washington Magnesite Company has closed a contract with the Stevens County Light & Power Company of Colville for furnishing 1000 h.p. at its mine and plant near Chewelah. To furnish the service the power company will have to extend its transmission lines about 8 miles from Chewelah. R. S. Talbot of Spokane is president of the Washington Magnesite Company.

OLYMPIA, WASH.—The county commissioners have granted to the Puget Sound Traction, Light & Power Company, a franchise for a period of 25 years, for the construction of a transmission line from Brown's ranch to the log cabin in this city. The new construction will begin about where the Pacific Highway crosses the Nisqually River and work will begin at once according to the petition.

SALT LAKE CITY, UTAH.—Plans have been drawn and surveys made for a modern hydroelectric plant and a storage reservoir in Red Butte Canyon, to furnish light and power. The estimated cost of the proposed improvement, money for which Utah's delegation in congress is now trying to have appropriated by the War Department, is from $100,000 to $125,000. The engineers who prepared the plans recommend construction of a reinforced concrete dam.

WALLACE, IDAHO.—The Shoshone County Power Company, recently organized, proposes to erect and operate an electric transmission line from a point near the Ray-Jefferson mine and thence to Prichard Creek, down Prichard Creek to Murray, a distance of 12 miles, with laterals, branches and extensions, which will cost between $30,000 and $35,000. The line when completed will furnish energy for extensive dredging operations to be carried on along Prichard Creek by the Guggenheim interests.

TACOMA, WASH.—Bids will be received by H. F. Gronen, commissioner of light and water, until July 2, 1917, for furnishing and delivering two lighting feeder panels with their appurtenant equipment, for installation in the city's substation, according to specifications on file in the office of the commissioner. Bids will also be accepted for the following as a whole or in separate items: Polished marble switch board material, voltage regualtors, disconnecting switches, oil circuit breakers, insulated cables, fibre copper and bus bar copper.

FRESNO, CAL.—Congress has finally apportioned $253,000 for the Yosemite National Park. This action will enable Manager Lewis to complete the new power plant this fall and to continue the building of the new roadway on an easy grade connecting El Portal with the park. Lewis now has 250 men, including 30 rangers, under him, and may add a few more after July 1. The power plant which he now expects to complete this fall will have a capacity of 2000 kilowatts, or 2667 horsepower. Located near Cascade Falls near the valley and up to Glacier Point, to light and furnish heat and power for the camps and hotels.

SAN FRANCISCO, CAL.—Further development of the Spaulding project has been started by the engineering department of the Pacific Gas & Electric Company, which is to install a power house about 600 ft. below the big Spaulding dam and generate 5000 additional horsepower. When the dam was installed this power house was one of the plans for the future development. With this plant in the chain the company will have approximately 72,000 horsepower from the Spaulding project. The power house, in which a big

turbine is to be installed, will be located about 600 ft. from the dam, and 5000 horsepower will be generated under a 173 ft. head of water. Heretofore this head has been going to waste, not generating power until it reached the Drumm power house. The development is in such a shape at the present time to allow of the installation of the adit and the saving of the waste. The new development entails a cost of about $125,000.

TELEPHONE AND TELEGRAPH

NORTH YAKIMA, WASH.—The Woodhouse Telephone Company has applied for a franchise to construct a telephone line on certain county roads.

TOLEDO, ORE.—The Pacific Telephone & Telegraph Company plans the standardizing of the equipment of that company within the next 60 days. The cost will be about $10,000.

SAN FRANCISCO, CAL.—C. L. Watson has applied for certificate of public convenience and necessity to construct a telephone system, before Examiner Encell at French Gulch.

PRESCOTT, ARIZ.—The Mountain States Telephone & Telegraph Company is surveying for a new telephone line between Prescott and Ash Fork, the line to be about 64 miles long.

SAFFORD, ARIZ.—There will soon be presented to the people of the lower portion of the valley a proposition looking to the installation of a telephone system covering towns on both sides of the river.

STOCKTON, CAL.—An ordinance has been passed granting the Pacific Telephone & Telegraph Company the right to erect and maintain poles, wires and conductors for the transmission of electricity upon the streets and alleys in city of Stockton.

WATSONVILLE, CAL.—The Pacific Telephone & Telegraph Company has applied for a 25 year renewal of its franchise, which has expired. The city clerk has been instructed to advertise for bids for a franchise, bids to be opened July 17th.

BRAWLEY, CAL.—Imperial Valley and San Diego may soon be connected by a long distance telephone line if plans of the Pacific Telephone & Telegraph Company are carried out. It is understood here that a third survey is being made for the company by engineers.

WINSLOW, ARIZ.—The Winslow telephone, system owned and operated for many years by A. J. Henderson, has been sold to W. C. Cooley. It is understood that it is the intention of the new owners to immediately expend several thousand dollars in making needed improvements in the system.

STOCKTON, CAL.—The Pacific Telephone & Te'egraph Company has been granted a 25 year franchise by the city council. For this franch'se the company pays the city $100 and 2 per cent of the gross annual receipts. Twenty-five main line telephones and 12 extensions are furnished to the city free of cost.

FRESNO, CAL.—Improvements to care for the present increase and future growth of the Pacific Telephone & Telegraph Company in this district are now under way and an appropriation of nearly $50,000 has been made by the main office, according to announcement made by W. F. Leh'gh, the local manager. Seven distinct improvements are being made in the system and the biggest part of the work will be completed within two months, while it will require at least 240 days on the work on the Fresno line.

IRRIGATION

WILLOWS, CAL.—Following a hearing the board of supervisors has declared the Jac'nto irrigation district petition sufficient in every particu'ar. The date of the final hearing was set for July 6th.

GRIDLEY, CAL.—Intimation that a compromise might be effected in the dispute between the Gridley Water Users' Association and the Sutter-Butte Canal Company was given at the hearing before Railroad Commissioner Frank R. Devlin.

WILLOWS, CAL.—The board of supervisors has begun hearing the petition of the Princeton district to be declared an irrigation district. It was this district that failed by one vote when the matter was up before the people last year. The same steps must be taken as were taken before that election by the supervisors. The district has now been thoroughly canvassed and it is believed when the subject is again presented to the people to vote upon that it will carry with practically no opposition.

PROSSER, WASH.—The special election of interesed property owners in Benton and Yakima counties under the Horse Heaven irrigation district, voted $18,000,000 in bonds to complete the project. About 215,000 acres can be watered at $45 per acre, 300,000 acres including reservoirs at $87 per acre. The main canal will be 150 miles long. The first meeting of an advisory commitee, elected recently, will be held with the board on July 3, at which time the rights of the Klickitat Irrigation & Power Company, the Northwestern Electric Company and Yearsley interests along the Klickitat river will be purchased. Prominent land owners claim the bonds can be sold as soon as validated. The engineers on the work are R. H. Thompson, Alaska building, Seattle; O. Laurgaard, Railway Exchange building, Portland, and A. J. Wiley, Butte, Mont. Some of the items of construction are as follows: One hundred and fifty miles of main canal, $8,000,000; two power and pumping plants, $500,000; six laterals, $1,979,000. Apparently the $18,000,000 does not provide for seven reservoirs originally contemplated under a $24,000,000 bond issue as these structures would cost a total of $8,833,000. Attorneys for the district are: Farrell, Kane & Stratton, American Bank building, Seattle; McGregor & Fristoe of Portland, and R. B. Williamson of North Yakima, Wash'ngon.

MANTECA, CAL.—H. F. Jackson, president of the Sierra and San Francisco Power Company, in a communication to the board of directors of the South San Joaquin irrigation district, stated that the Oakdale and San Joaquin distr'cts could secure the increased flow from its storage system for irrigation purposes late in the season by paying the power company 50c per acre-foot. The power company, in order to let the irrigation districts have the water when they need it most, will draw on its reservoirs for the period from late in July through October and use its steam plants at the end of the season instead of earlier, as is usually the case.

OROVILLE, CAL.—Supervisor C. E. Porter, who has been active in interesting farmers of the sect'on south of this city in an irrigation project, says the acreage necessary to insure the construction of a system has been pledged. Mr. Porter has submitted his report to the officials of the Great Western Canal Company and their action is awaited. It is said the contract is being considered. The plan under which Porter and Engineer Harry Cauthard of the canal company have been working calls for a mutual water district formed of land owners who desire water for their lands. The Great Western Canal Company asked a min'mum subscription of 10,000 acres.

LOS ANGELES, CAL.—It is stated by J. S. Jarrett, attorney of Imperial, that the U. S. government has entered into a contract with the Laguna Water Company for the building of a canal from Laguna dam into the Imperial Valley for irrigation of the east side mesa. The mesa comprises 180,000 acres. A company headed by Col. Holabird, F. H. Merrill, O. E. Freeman and W. B. Baker propose to conduct the waters of Baldwin Lake and Whitewater River to Imperial Valley for irrigation and domestic water supply. They propose to conduct this water to an impounding dam in Morengo Valley and then to Coachella and Imperial Valleys by way of Palm Springs. Cities of Imperial Valley are asked to raise $100,000 toward the project. Power plants are to be developed at the southern end of Morengo Valley and Palm Springs.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page preceeding

A-1 **American Ever-Ready Works of National Carbon Co**
Los Angeles; 755 Folsom St., San Francisco; Seattle.

B-1 **Baker-Joslyn Company** 2
71-75 New Montgomery St., San Francisco; 911 Western Ave., Seattle; 353 Second St., Los Angeles.

C-1 **Century Electric Co** 19
906 So. Hope St., Los Angeles; 56 Natoma St., San Francisco; 65 Front St., Portland, Ore.

C-3 **Crocker-Wheeler Co** .....
87 New Montgomery St., San Francisco; 228 Central Avenue, Los Angeles.

C-5 **Crouse-Hinds Company** .....
Syracuse, N. Y., U. S. A.
New York, Boston, Cincinnati, Chicago.

C-4 **Cutler-Hammer Manufacturing Co** 12
579 Howard St., San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-1 **Detroit Fuse & Manufacturing Co** 3
1404 Rivard Street. Detroit, Mich.

E-1 **Edison Lamp Works of General Electric Co** .....
Rialto Bldg., San Francisco; 724 So. Spring St., Los Angeles.

E-2 **Edison Storage Battery Supply Co** 14
206-8-10 First St., (near Howard), San Francisco.

E-3 **Electric Agencies Co** .....
279-283 Minna St., San Francisco; 419-421 E. Third St., Los Angeles.

E-4 **Electric Storage Battery Co** 19
1536 Bush St., San Francisco.

E-5 **Electric, Railway & Manufacturing Supply Co** 10
34 Second St., San Francisco.

E-6 **Electric Novelty Works** .....
533 Mission St., San Francisco.

E-7 **Economy Fuse & Mfg. Co** .....
Kinzie and Orleans Sts., Chicago.

F-3 **Federal Electric Company** 11
618 Mission St., San Francisco.

G-1 **General Electric Co** 20–21
724 So. Spring St., Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.

G-2 **Great Western Securities Corporation** .....
302-3-4 Hobart Bldg., San Francisco.

H-1 **Habirshaw Electric Cable Co., Inc** .....
(See Western Electric Company.)

H-2 **Hemingray Glass Co** 10
236-240 So. Los Angeles St., Los Angeles; 345 Oak St., Portland; 807 Mission St., San Francisco.

H-3 **Haller-Cunningham Electric Co** .....
428 Market St., San Francisco.

H-5 **Hotpoint Electric Heating Co** 1
Ontario, Cal.

H-4 **Hubbard & Co** 17
(See Pacific States Elec. Co.)

H-7 **Hurley Machine Co** 16
New York and Chicago. (See Pacific States Electric Co.)

I-2 **Illinois Electric Co** .....
261-263 So. Los Angeles St., Los Angeles.

I-3 **Interstate Electric Novelty Co** .....
111 New Montgomery St., San Francisco.

L-2 **Locke Insulator Manufacturing Co** 13
(See Pierson, Roeding & Co.)

M-3 **Moore & Co., Charles C** 15
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland; Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson.

N-1 **Nason & Co., R. N** .....
151 Potrero Ave., San Francisco.

N-2 **National Conduit & Cable Co., The** .....
Trust and Savings Bldg., Los Angeles; Rialto Bldg., San Francisco.

N-3 **National Lamp Works of G. E. Co** 13
(All Jobbers.)

N-4 **New York Insulated Wire Co** .....
629 Howard St., San Francisco.

N-5 **Northwestern Pacific** 14
Ferry Bldg., San Francisco.

N-6 **National Carbon Co** .....
Cleveland, Ohio.

O-1 **Okonite Co. (The)** 22
(All Jobbers.)

P-2 **Pacific States Electric Co** 16
236-240 So. Los Angeles St., Los Angeles; 61-67 Fifth St. No., Portland; 200-210 Twelfth St., Oakland; 575 Mission St., San Francisco; 307 First Ave. So., Seattle.

P-5 **Pierson, Roeding & Co** 15
Pacific Electric Bldg., Los Angeles; Rialto Bldg., San Francisco; Colman Bldg., Seattle.

P-7 **Pittsburgh Piping & Equipment Co** 22
Monadnock Bldg., San Francisco.

S-4 **Southern Pacific Co** 18
Flood Bldg., San Francisco.

S-5 **Sprague Electric Works** 15
Rialto Bldg., San Francisco; Colman Bldg., Seattle; Corporation Bldg., Los Angeles; Electric Bldg., Portland; Paulsen Bldg., Spokane.

S-6 **Standard Underground Cable Co** 15
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Central Bldg., Seattle, Wash.; 815 Newhouse Bldg., Salt Lake City, Utah.

T-1 **Thomas & Co., R** 18
Pacific States Electric Co. and Western Electric Co., Pacific Coast Representatives.

T-2 **Tubular Woven Fabric Company** .....
Pawtucket, R. I.

U-1 **United Sheet Metal Works** .....
575 Howard St., San Francisco.

W-1 **Wagner Electric Manufacturing Company** 18
St. Louis, Mo.

W-2 **Western Electric Co** 14
Eighth and Santee Sts., Los Angeles; 1900 Telegraph Ave., Oakland, Cal.; 680 Folsom St., San Francisco; 907 First Ave., Seattle; 45 North Fifth St., Portland, Ore.

W-3 **Ward-Leonard Electric Co** 22
Mt. Vernon, New York.

W-4 **Westinghouse Electric & Manufacturing Co** 4-5-6
50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; First National Bank Bldg., San Francisco; Second and Cherry Sts., Seattle; Paulsen Bldg., Spokane.

W-6 **Westinghouse Lamp Co** .....
(See Westinghouse Electric & Manufacturing Co.)

W-8 **Western Pipe & Steel Co** .....
444 Market St., San Francisco; 1758 North Broadway, Los Angeles.

W-9 **Weston Electrical Instrument Co** 15
109 Weston Ave., Newark, N. J.; Frank E. Smith, 682 Mission St., San Francisco.

Y-1 **Youngstown Sheet & Tube Co** .....
Youngstown, Ohio.